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Please provide a detailed statement of the search topic, and describe as specifically as possible the subject matter to be searched. Include the elected species or structures, keywords, synonyms, acronyms, and registry numbers, and combine with the concept or utility of the invention. Define any terms that may have a special meaning. Give examples or relevant citations, authors, etc, if known. Please attach a copy of the cover sheet, pertinent claims, and abstract.

Title of Invention:

Inventors (please provide full names):

See front sheet

Earliest Priority Filing Date:

\*For Sequence Searches Only\* Please include all pertinent information (parent, child, divisional, or issued patent numbers) along with the appropriate serial number.

Could you search for a polymeric electrolyte comprising  
- a crosslinked polyether urethane prepared by  
reacting a prepolymer having polyetherylene oxide  
backbone & terminated with NCO with  
a crosslinking agent  
- An organic solvent & lithium salt

Thanks,  
Laura

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Searcher: K. Fuller Type of Search: NA Sequence (#) Vendors and cost where applicable: STN  
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STRUCTURE FILE UPDATES: 25 JUN 2003 HIGHEST RN 537653-06-8  
DICTIONARY FILE UPDATES: 25 JUN 2003 HIGHEST RN 537653-06-8

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FILE LAST UPDATED: 25 Jun 2003 (20030625/ED)

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L2 32 SEA FILE=REGISTRY ABB=ON (25322-68-3/BI OR 7439-93-2/BI OR  
101-68-8/BI OR 105-58-8/BI OR 108-32-7/BI OR 12190-79-3/BI OR  
132902-95-5/BI OR 14283-07-9/BI OR 21324-40-3/BI OR 25322-69-4/  
BI OR 25791-96-2/BI OR 26851-39-8/BI OR 31694-55-0/BI OR  
33454-82-9/BI OR 4098-71-9/BI OR 502-44-3/BI OR 56-87-1/BI OR  
584-84-9/BI OR 616-38-6/BI OR 623-53-0/BI OR 64743-80-2/BI OR  
70198-24-2/BI OR 7564-64-9/BI OR 7791-03-9/BI OR 79371-37-2/BI  
OR 822-06-0/BI OR 872-36-6/BI OR 9002-88-4/BI OR 9003-07-0/BI  
OR 90076-65-6/BI OR 91-08-7/BI OR 96-49-1/BI)

L3 7 SEA FILE=REGISTRY ABB=ON L2 AND 1/LI  
 L4 10 SEA FILE=REGISTRY ABB=ON L2 AND ISOCYAN?  
 L5 1 SEA FILE=REGISTRY ABB=ON "POLYETHYLENE OXIDE"/CN  
 L6 1 SEA FILE=REGISTRY ABB=ON "POLYPROPYLENE GLYCOL"/CN  
 L7 1 SEA FILE=REGISTRY ABB=ON "POLYETHYLENE GLYCOL"/CN  
 L8 2 SEA FILE=REGISTRY ABB=ON (L5 OR L6 OR L7)  
 L9 230404 SEA FILE=HCAPLUS ABB=ON L4 OR NCO OR ?URETHAN? OR ?ISOCYANAT?  
  
 L10 182644 SEA FILE=HCAPLUS ABB=ON L8 OR POLYETHYLENE OXIDE OR POLYOXYALK  
 YLENE# OR (POLYPROPYLENE OR POLYETHYLENE) (W) GLYCOL OR POLYOXYET  
 HYLENE OR POLYOXYPROPYLENE  
 L11 26104 SEA FILE=HCAPLUS ABB=ON L9 AND L10  
 L12 342226 SEA FILE=HCAPLUS ABB=ON L3 OR LI OR LITHIUM  
 L13 554 SEA FILE=HCAPLUS ABB=ON L11 AND L12  
 L14 152 SEA FILE=HCAPLUS ABB=ON L13 AND CROSSLINK?  
 L15 18646 SEA FILE=HCAPLUS ABB=ON POLYMER?(S) ELECTROLYTE?  
 L16 82 SEA FILE=HCAPLUS ABB=ON L14 AND L15  
 L17 21659 SEA FILE=HCAPLUS ABB=ON L9(L) L10  
 L18 61 SEA FILE=HCAPLUS ABB=ON L16 AND L17  
 L19 24 SEA FILE=HCAPLUS ABB=ON L18 AND (PREP OR SPN OR IMF)/RL  
 L20 33 SEA FILE=HCAPLUS ABB=ON L18 AND BATTER?  
 L21 44 SEA FILE=HCAPLUS ABB=ON L19 OR L20

=> d 121 1-44 all hitstr

L21 ANSWER 1 OF 44 HCAPLUS COPYRIGHT 2003 ACS

AN 2003:222725 HCAPLUS

DN 138:386197

TI Phase transfer catalytic property and ion conductivity of  
**polyoxyethylene**-containing interpenetrating polymer networks and  
 of their LiClO<sub>4</sub> complexes

AU Xie, Hong-Quan; Wang, Guigui

CS Department of Chemistry, Huazhong University of Science and Technology,  
 Wuhan, 430074, Peop. Rep. China

SO Polymeric Materials Science and Engineering (2003), 88, 372-373  
 CODEN: PMSEDG; ISSN: 0743-0515

PB American Chemical Society

DT Journal; (computer optical disk)

LA English

CC 37-5 (Plastics Manufacture and Processing)

Section cross-reference(s): 38, 45

AB Simultaneous grafted interpenetrating polymer networks (IPNs) based on  
 (castor oil-**polyethylene glycol**) **polyurethane**  
 and poly[alkyl (meth)acrylate] were synthesized by coupling castor oil and  
**polyethylene glycol** (PEG) with 2,4-toluene  
**diisocyanate** and by radical polymn. of alkyl (meth)acrylate with  
 castor oil simultaneously at ambient temp. The gel contents of the IPNs  
 were higher about 96% in most cases. The IPN was characterized by IR  
 spectrum. Effects of compositional variation of the IPNs on phase  
 transfer catalytic efficiency and mech. properties, as well as cond. of  
 the IPNs complexed with LiClO<sub>4</sub> were studied. The results showed that the  
 IPNs have good phase transfer catalytic ability in the Williamson reaction  
 and exhibited a max. conversion of potassium phenolate at 55% PEO. The  
 phase transfer catalytic ability of the IPN increases with mol. wt. of PEG  
 used in the IPN synthesis and with the length of alkyl groups of the  
 grafts, but decreases with increasing **crosslinking** degree. The  
 complex of the IPNs with LiClO<sub>4</sub> exhibited good ionic cond. in the range of

10-5 S/cm to  $3 \times 10^{-4}$  S/cm, which decreases with increasing either the **crosslinking** degree or the mol. wt. of PEG used, but increases with increasing PEO content. The more the compatibility of the grafts with PEO, the lower is the cond. Bu methacrylate or Et methacrylate is better to be used as the monomer in synthesis of the IPNs for phase transfer catalyst and ion conducting material. The IPNs showed high tensile strength in the range of 10-20 MPa. The good mech. properties of the IPNs favor the application of them as a strong solid **polymer electrolyte** film and an easily recoverable phase transfer catalyst.

- ST **polyoxyethylene polyurethane** interpenetrating network  
**lithium** complex; ionic cond **polyoxyethylene**  
**polyurethane** interpenetrating network **lithium**;  
 polymethacrylate interpenetrating network **lithium** complex  
**polyoxyethylene**; polyacrylate interpenetrating network  
**lithium** complex **polyoxyethylene**; phase transfer catalyst  
 Williamson reaction **lithium**
- IT Alkoxylation catalysts  
 (Williamson; phase-transfer catalytic property and ion cond. of  
**polyoxyethylene**-contg. interpenetrating polymer networks and of  
 their LiClO<sub>4</sub> complexes)
- IT Interpenetrating polymer networks  
 Ionic conductivity  
**Polymer electrolytes**  
 Tensile strength  
 (phase-transfer catalytic property and ion cond. of  
**polyoxyethylene**-contg. interpenetrating **polymer**  
 networks and of their LiClO<sub>4</sub> complexes)
- IT Castor oil  
 RL: CAT (Catalyst use); POF (Polymer in formulation); PRP (Properties);  
**SPN (Synthetic preparation)**; **PREP (Preparation)**; USES  
 (Uses)  
 (polymers with TDI and **polyethylene glycol**;  
 phase-transfer catalytic property and ion cond. of  
**polyoxyethylene**-contg. interpenetrating polymer networks and of  
 their LiClO<sub>4</sub> complexes)
- IT **Polyoxyalkylenes**, preparation  
 RL: CAT (Catalyst use); POF (Polymer in formulation); PRP (Properties);  
**SPN (Synthetic preparation)**; **PREP (Preparation)**; USES  
 (Uses)  
 (polymers with castor oil and TDI, **lithium** complexes;  
 phase-transfer catalytic property and ion cond. of  
**polyoxyethylene**-contg. interpenetrating polymer networks and of  
 their LiClO<sub>4</sub> complexes)
- IT **Polyurethanes**, preparation  
 RL: CAT (Catalyst use); POF (Polymer in formulation); PRP (Properties);  
**SPN (Synthetic preparation)**; **PREP (Preparation)**; USES  
 (Uses)  
 (**polyoxyalkylene**-; phase-transfer catalytic property and ion  
 cond. of **polyoxyethylene**-contg. interpenetrating polymer  
 networks and of their LiClO<sub>4</sub> complexes)
- IT **7439-93-2DP, Lithium**, complexes with  
**polyethylene glycol**-contg. **polyurethanes**  
 9003-20-7P, Poly(vinyl acetate) 9003-32-1P, Poly(ethyl acrylate)  
 9003-42-3P, Poly(ethyl methacrylate) 9003-49-0P, Poly(butyl acrylate)  
 9011-14-7P, PMMA **25322-68-3DP, Polyethylene**  
**glycol**, polymers with castor oil and TDI, **lithium**  
 complexes 26471-62-5DP, TDI, polymers with castor oil and

**polyethylene glycol, lithium complexes**

RL: CAT (Catalyst use); POF (Polymer in formulation); PRP (Properties);  
**SPN (Synthetic preparation); PREP (Preparation); USES**  
 (Uses)

(phase-transfer catalytic property and ion cond. of  
**polyoxyethylene**-contg. interpenetrating polymer networks and of  
 their LiClO<sub>4</sub> complexes)

IT 100-67-4, Potassium phenolate 109-65-9, n-Butyl bromide

RL: RCT (Reactant); RACT (Reactant or reagent)

(phase-transfer catalytic property and ion cond. of  
**polyoxyethylene**-contg. interpenetrating polymer networks and of  
 their LiClO<sub>4</sub> complexes)

RE.CNT 9 THERE ARE 9 CITED REFERENCES AVAILABLE FOR THIS RECORD

RE

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- (2) Guler, H; J Appl Polym Sci 1997, V66(13), P2475 HCAPLUS
- (3) Kim, J; J Biomater Sci Polym Ed 2000, V11(2), P197 HCAPLUS
- (4) Li, M; J Polym Res 1996, V3(3), P175
- (5) Pitsikalis, M; Adv Polym Sci 1998, V135, P1 HCAPLUS
- (6) Velichkova, R; Progr Polym Sci 1995, V20, P819 HCAPLUS
- (7) Wang, M; Guizhou Gongxueyuan Xuebao 1995, V24(5), P8 HCAPLUS
- (8) Xie, H; Eur Polym Sci 1994, V30(11), P1537
- (9) Xie, H; Prog Polym Sci 1999, V24, P275 HCAPLUS

IT 7439-93-2DP, **Lithium**, complexes with

**polyethylene glycol**-contg. **polyurethanes**

**25322-68-3DP, Polyethylene glycol**, polymers

with castor oil and TDI, **lithium complexes**

RL: CAT (Catalyst use); POF (Polymer in formulation); PRP (Properties);

**SPN (Synthetic preparation); PREP (Preparation); USES**

(Uses)

(phase-transfer catalytic property and ion cond. of  
**polyoxyethylene**-contg. interpenetrating polymer networks and of  
 their LiClO<sub>4</sub> complexes)

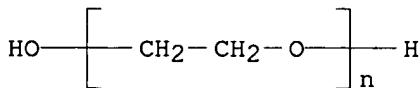
RN 7439-93-2 HCAPLUS

CN Lithium (7CI, 8CI, 9CI) (CA INDEX NAME)

Li

RN 25322-68-3 HCAPLUS

CN Poly(oxy-1,2-ethanediyl), .alpha.-hydro-.omega.-hydroxy- (9CI) (CA INDEX NAME)



L21 ANSWER 2 OF 44 HCAPLUS COPYRIGHT 2003 ACS

AN 2002:916784 HCAPLUS

DN 138:272294

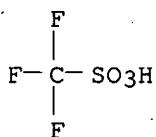
TI Novel gel **polymer electrolytes** based on a cellulose  
 ester with PEO side chains

AU Yue, Z.; McEwen, I. J.; Cowie, J. M. G.

CS Department of Chemistry, Heriot-Watt University, Edinburgh, EH14 4AS, UK

- SO Solid State Ionics (2003) 156(1,2), 155-162  
CODEN: SSIOD3; ISSN: 0167-2738
- PB Elsevier Science B.V.
- DT Journal
- LA English
- CC 37-5 (Plastics Manufacture and Processing)  
Section cross-reference(s): 52, 76
- AB A range of gel electrolytes, composed of a hydroxypropyl cellulose esters with oligomeric poly(oxyethylene) side chains, LiCF<sub>3</sub>SO<sub>3</sub>, and propylene carbonate (PrC), or a mixt. of PrC with ethylene carbonate (EtC), were prepd. and studied. The conductivities of gels contg. 10% LiCF<sub>3</sub>SO<sub>3</sub>, and having PrC concns. varying from 20-70%, exhibit Arrhenius behavior with activation energies ranging from 16-34 kJ mol<sup>-1</sup>. Room temp. conductivities of the order of 10<sup>-3</sup> S cm<sup>-1</sup> are achieved with PrC contents above 50%. Gels contg. 70% PrC, or a mixts. of PrC and EtC, were **crosslinked** to form elastomeric films exhibiting good mech. properties and room temp. conductivities of .apprx.10<sup>-3</sup> S cm<sup>-1</sup>. The conductivities and mech. strength of these films increased with increasing EtC content. An Arrhenius dependence of log cond. on (1/T) is also obsd. in these films, with activation energies for ion transport around 16 kJ mol<sup>-1</sup>.
- ST hydroxypropyl cellulose **polyoxyethylene** ester electrolyte ionic cond
- IT Glass transition temperature  
Ionic conductivity  
**Polymer electrolytes**  
Stress-strain relationship  
(prepn. and properties of **polymer electrolyte** gels based on hydroxypropyl cellulose **polyoxyethylene** esters)
- IT **33454-82-9, Lithium** triflate  
RL: MOA (Modifier or additive use); USES (Uses)  
(dopant; prepn. and properties of **polymer electrolyte** gels based on hydroxypropyl cellulose **polyoxyethylene** esters)
- IT 96-49-1, Ethylene carbonate 108-32-7, Propylene carbonate  
RL: MOA (Modifier or additive use); USES (Uses)  
(plasticizer; prepn. and properties of **polymer electrolyte** gels based on hydroxypropyl cellulose **polyoxyethylene** esters)
- IT **7439-93-2DP, Lithium**, complexes with **crosslinked** cellulose ester with poly(ethylene oxide) side chains 503534-39-2DP, Tris(hydroxypropyl) cellulose ester with .alpha.-(carboxymethyl)-.omega.-methoxypoly(oxy-1,2-ethanediyl)-hexamethylene **diisocyanate** copolymer, **lithium** complexes  
RL: POF (Polymer in formulation); PRP (Properties); SPN (Synthetic preparation); PREP (Preparation); USES (Uses)  
(prepn. and properties of **polymer electrolyte** gels based on hydroxypropyl cellulose **polyoxyethylene** esters)
- RE.CNT 23 THERE ARE 23 CITED REFERENCES AVAILABLE FOR THIS RECORD
- RE
- (1) Abbrent, S; Electrochim Acta 1998, V43, P1185 HCAPLUS
  - (2) Anon; IUPAC Acid--Base Dissociation Constants in Dipolar Aprotic Solvents 1990
  - (3) Cameron, G; Polymer Electrolyte Reviews 1989, V2
  - (4) Cowie, J; Br Polym J 1988, V20, P247 HCAPLUS
  - (5) Cowie, J; Macromol Symp 1995, V98, P843 HCAPLUS
  - (6) Cowie, J; Polymer 1989, V30, P509 HCAPLUS
  - (7) Cowie, J; Polymer 1998, V39, P7139 HCAPLUS
  - (8) Crank, J; The Mathematics of Diffusion, 2nd ed 1995

- (9) Forsyth, M; Electrochim Acta 1995, V40, P2339 HCAPLUS  
 (10) Forsyth, M; Electrochim Acta 1995, V40, P2343 HCAPLUS  
 (11) Forsyth, M; Electrochim Acta 1995, V40, P2349 HCAPLUS  
 (12) Gray, F; Solid Polymer Electrolytes: Fundamentals and Technological Applications 1991  
 (13) Hirahara, K; Extended Abstract of the Ninth International Meeting on Lithium Batteries 1998  
 (14) Huang, W; Electrochim Acta 1995, V40, P2147 HCAPLUS  
 (15) Kim, S; J Appl Polym Sci 2001, V81, P948 HCAPLUS  
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 (18) MacFarlane, D; Electrochim Acta 1995, V13, P2333  
 (19) Murata, K; Electrochim Acta 2000, V45, P1501 HCAPLUS  
 (20) Song, J; J Power Sources 1999, V77, P183 HCAPLUS  
 (21) Sun, X; Solid State Ionics 1996, V83, P79 HCAPLUS  
 (22) Wright, P; Electrochim Acta 1998, V43, P1137 HCAPLUS  
 (23) Yue, Z; Polymer (in press)  
 IT **33454-82-9, Lithium** triflate  
 RL: MOA (Modifier or additive use); USES (Uses)  
 (dopant; prepn. and properties of **polymer electrolyte**  
 gels based on hydroxypropyl cellulose **polyoxyethylene** esters)  
 RN 33454-82-9 HCAPLUS  
 CN Methanesulfonic acid, trifluoro-, lithium salt (8CI, 9CI) (CA INDEX NAME)



Li

- IT **7439-93-2DP, Lithium**, complexes with **crosslinked**  
 cellulose ester with poly(ethylene oxide) side chains  
 RL: POF (Polymer in formulation); PRP (Properties); **SPN (Synthetic**  
**preparation); PREP (Preparation);** USES (Uses)  
 (prepn. and properties of **polymer electrolyte** gels  
 based on hydroxypropyl cellulose **polyoxyethylene** esters)  
 RN 7439-93-2 HCAPLUS  
 CN Lithium (7CI, 8CI, 9CI) (CA INDEX NAME)

Li

- L21 ANSWER 3 OF 44 HCAPLUS COPYRIGHT 2003 ACS  
 AN 2002:734227 HCAPLUS  
 DN 137:256174  
 TI **Crosslinked** conductive polymers with stable conductivity under  
 various conditions having flexible **polyoxyalkylene**-polycarbonate  
 groups  
 IN Kijima, Tetsuo; Toyama, Yasunori; Akimoto, Mamoru; Nozu, Takashi;  
 Kobayashi, Toshihide



PA Nippon Polyurethane Industry Co., Ltd., Japan  
 SO Jpn. Kokai Tokkyo Koho, 13 pp.  
 CODEN: JKXXAF  
 DT Patent  
 LA Japanese  
 IC ICM H01B001-12  
 ICS C08F002-44; C08F220-28; C08F287-00; C08F290-14; C08G018-38;  
 C08G018-46; C08G018-50; H01M010-40  
 CC 76-2 (Electric Phenomena)  
 Section cross-reference(s): 38

FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	JP 2002279827	A2	20020927	JP 2001-76344	20010316
PRAI	JP 2001-76344		20010316		

AB The **crosslinked** polymers, useful for **batteries**, capacitors, etc., comprise compds. having a structure unit  $R_1(OR_2)nO(R_3OCO_2)_m$  ( $R_1 = C_1-5$ -alkyl;  $R_2, R_3 = C_2-10$ -linear, branched, cyclic aliph. group;  $m, n \geq 1$ ) and compds. having multiple polymerizable groups. The **polyoxyalkylene**-polycarbonate groups may be linked with the main chains via acryloyl groups or carbamate groups.

ST conductive polymer **polyoxyalkylene** polycarbonate flexible pendant; **polymer electrolyte crosslinked** cond stability

IT **Polymer electrolytes**  
 (crosslinked polymer electrolytes with stable cond. having flexible **polyoxyalkylene**-polycarbonate groups)

IT **Polyoxyalkylenes**, uses  
 RL: TEM (Technical or engineered material use); USES (Uses)  
 (polycarbonate-, acrylic; **crosslinked polymer electrolytes** with stable cond. having flexible **polyoxyalkylene**-polycarbonate groups)

IT **Polyurethanes**, uses  
 RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)  
 (polycarbonate-**polyoxyalkylene**-; **crosslinked polymer electrolytes** with stable cond. having flexible **polyoxyalkylene**-polycarbonate groups)

IT **Polyoxyalkylenes**, uses  
 RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)  
 (polycarbonate-**polyurethane**-; **crosslinked polymer electrolytes** with stable cond. having flexible **polyoxyalkylene**-polycarbonate groups)

IT Polycarbonates, uses  
 RL: TEM (Technical or engineered material use); USES (Uses)  
 (**polyoxyalkylene**-, acrylic; **crosslinked polymer electrolytes** with stable cond. having flexible **polyoxyalkylene**-polycarbonate groups)

IT Polycarbonates, uses  
 RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)  
 (**polyoxyalkylene**-**polyurethane**-; **crosslinked polymer electrolytes** with stable cond. having flexible **polyoxyalkylene**-polycarbonate groups)

IT 460986-47-4DP, Diethyl carbonate-ethoxylated glycerin-1,6-hexanediol-MDI

copolymer, carbamates with **polyethylene glycol** monomethyl ether 460986-48-5DP, carbamates with **polyethylene glycol** monomethyl ether 460986-49-6DP, carbamates with **polyethylene glycol** monomethyl ether 460986-50-9DP, carbamates with **polyethylene glycol** monomethyl ether  
 RL: **IMF (Industrial manufacture)**; TEM (Technical or engineered material use); **PREP (Preparation)**; USES (Uses)

(**crosslinked polymer electrolytes** with stable cond. having flexible **polyoxyalkylene**-polycarbonate groups)

IT **7439-93-2, Lithium, uses**

RL: MOA (Modifier or additive use); TEM (Technical or engineered material use); USES (Uses)

(dopant; **crosslinked polymer electrolytes** with stable cond. having flexible **polyoxyalkylene**-polycarbonate groups)

IT **7439-93-2, Lithium, uses**

RL: MOA (Modifier or additive use); TEM (Technical or engineered material use); USES (Uses)

(dopant; **crosslinked polymer electrolytes** with stable cond. having flexible **polyoxyalkylene**-polycarbonate groups)

RN 7439-93-2 HCAPLUS

CN Lithium (7CI, 8CI, 9CI) (CA INDEX NAME)

Li

L21 ANSWER 4 OF 44 HCAPLUS COPYRIGHT 2003 ACS

AN 2002:727146 HCAPLUS

DN 137:248720

TI **Crosslinkable** polycarbonates with good stability and weather resistance

IN Kijima, Tetsuo; Toyama, Yasunori; Akimoto, Mamoru; Nozu, Takashi; Kobayashi, Toshihide

PA Nippon Polyurethane Industry Co., Ltd., Japan

SO Jpn. Kokai Tokkyo Koho, 12 pp.

CODEN: JKXXAF

DT Patent

LA Japanese

IC ICM C08G018-44

ICS C08F299-02; H01B001-06; H01M004-62; H01M008-02; H01M010-40

CC 38-3 (Plastics Fabrication and Uses)

Section cross-reference(s): 52

FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	JP 2002275234	A2	20020925	JP 2001-76375	20010316
PRAI	JP 2001-76375		20010316		

AB The polycarbonates, useful as electrode binders, **polymer electrolytes** for secondary **batteries**, etc., are prepd. by **polymn.** of polycarbonates contg. (R1OCO2)m and (R2OCO2)n [R1 = hetero atom-contg. C2-10 divalent group; R2 = hetero atom-contg. cyclic or branched C2-10 divalent group; m, n > 0]. Thus, a soln. contg. a polycarbonate diol (Mn 500, m/n 7/3) prepd. from 1,6-hexamethylenediol, 3-methyl-1,5-pentanediol, and di-Et carbonate, MDI, ethoxylated glycerin,

and LiCF<sub>3</sub>SO<sub>3</sub> as a dopant was applied on an electrode and cured to give a **crosslinked polymer electrolyte** with ion cond. at 25.degree. and relative humidity 55% 2 .times. 10<sup>-4</sup> Scm<sup>-1</sup>.

- ST **crosslinked polymer polycarbonate electrode binder secondary battery**; hexamethylenediol methylpentanediol carbonate MDI **polyoxyethylene glycerin polymer**; **polymer electrolyte lithium fluoromethanesulfonate polyoxyethylene polycarbonate complex**
- IT **Battery electrodes**  
**Battery electrolytes**  
 Secondary **batteries**  
 (**crosslinkable** polycarbonates with good stability and weather resistance)
- IT **Binders**  
 (for secondary **battery** electrode; **crosslinkable** polycarbonates with good stability and weather resistance)
- IT **Polymer electrolytes**  
 (for secondary **battery**; **crosslinkable** polycarbonates with good stability and weather resistance)
- IT **Polyurethanes, uses**  
 RL: **IMF (Industrial manufacture)**; TEM (Technical or engineered material use); **PREP (Preparation)**; **USES (Uses)**  
 (polycarbonate-; **crosslinkable** polycarbonates with good stability and weather resistance)
- IT **Polyurethanes, uses**  
 RL: **IMF (Industrial manufacture)**; TEM (Technical or engineered material use); **PREP (Preparation)**; **USES (Uses)**  
 (polycarbonate-polyether-, **lithium** complexes, trifluoromethanesulfonate-contg.; **crosslinkable** polycarbonates with good stability and weather resistance)
- IT **Polyurethanes, uses**  
 RL: **IMF (Industrial manufacture)**; TEM (Technical or engineered material use); **PREP (Preparation)**; **USES (Uses)**  
 (polycarbonate-**polyoxyalkylene**-, **lithium** complexes, trifluoromethanesulfonate-contg.; **crosslinkable** polycarbonates with good stability and weather resistance)
- IT **Polyethers, uses**  
**Polyoxyalkylenes, uses**  
 RL: **IMF (Industrial manufacture)**; TEM (Technical or engineered material use); **PREP (Preparation)**; **USES (Uses)**  
 (polycarbonate-**polyurethane**-, **lithium** complexes, trifluoromethanesulfonate-contg.; **crosslinkable** polycarbonates with good stability and weather resistance)
- IT **Polycarbonates, uses**  
 RL: **IMF (Industrial manufacture)**; TEM (Technical or engineered material use); **PREP (Preparation)**; **USES (Uses)**  
 (polyether-**polyurethane**-, **lithium** complexes, trifluoromethanesulfonate-contg.; **crosslinkable** polycarbonates with good stability and weather resistance)
- IT **Polycarbonates, uses**  
 RL: **IMF (Industrial manufacture)**; TEM (Technical or engineered material use); **PREP (Preparation)**; **USES (Uses)**  
 (**polyoxyalkylene-polyurethane**-, **lithium** complexes, trifluoromethanesulfonate-contg.; **crosslinkable** polycarbonates with good stability and weather resistance)
- IT **Polycarbonates, uses**  
 RL: **IMF (Industrial manufacture)**; TEM (Technical or engineered material use); **PREP (Preparation)**; **USES (Uses)**

(polyurethane-; crosslinkable polycarbonates with good stability and weather resistance)

IT 140936-35-2P 461317-47-5P 461317-52-2P 461317-57-7P  
 RL: IMF (Industrial manufacture); RCT (Reactant); PREP (Preparation); RACT (Reactant or reagent)  
 (crosslinkable polycarbonates with good stability and weather resistance)

IT 7439-93-2DP, Lithium, polyoxyethylene  
 -polycarbonate complexes, trifluoromethanesulfonate-contg. 460986-49-6DP, lithium complexes, trifluoromethanesulfonate-contg. 461317-67-9DP, lithium complexes, trifluoromethanesulfonate-contg. 461317-73-7DP, lithium complexes, trifluoromethanesulfonate-contg. 461317-78-2DP, lithium complexes, trifluoromethanesulfonate-contg. 461317-83-9P  
 RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)  
 (crosslinkable polycarbonates with good stability and weather resistance)

IT 7439-93-2DP, Lithium, polyoxyethylene  
 -polycarbonate complexes, trifluoromethanesulfonate-contg. RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)  
 (crosslinkable polycarbonates with good stability and weather resistance)

RN 7439-93-2 HCAPLUS  
 CN Lithium (7CI, 8CI, 9CI) (CA INDEX NAME)

Li

L21 ANSWER 5 OF 44 HCAPLUS COPYRIGHT 2003 ACS  
 AN 2002:573561 HCAPLUS  
 DN 137:143032  
 TI Polymer solid electrolyte, electrochemical element using the electrolyte, and secondary battery  
 IN Maeda, Seiji; Saito, Takaichiro  
 PA Nippon Synthetic Chemical Industry Co., Ltd., Japan  
 SO Jpn. Kokai Tokkyo Koho, 12 pp.  
 CODEN: JKXXAF  
 DT Patent  
 LA Japanese  
 IC ICM H01M010-40  
 ICS C08F002-44; C08F002-50; C08F290-06; C08F299-02; C08K005-00; C08L071-00; H01B001-06  
 CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
 FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	JP 2002216845	A2	20020802	JP 2001-10621	20010118
PRAI	JP 2001-10621		20010118		

AB The electrolyte has an electrolyte salt in a polymer matrix, which is a crosslinked copolymer of a urethane (meth)acrylate and monomer  $\text{CH}_2\text{:CRCO}[(\text{OCH}_2\text{CH}_2)_k(\text{OC}_3\text{H}_6)_l(\text{OC}_2\text{CH}_2\text{CH}_2\text{CH}_2)_m]\text{OR}'$ , where R = H or Me, R' = H, C1-18 (branched) alkyl group, k, l, and m = integers and  $(k+l+m) \geq 1$ . The electrochem. element and secondary Li battery use the electrolyte.

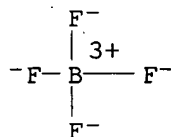
ST secondary lithium battery electrolyte acrylate  
crosslinked copolymer; urethane polyoxyalkylene  
acrylate crosslinked copolymer battery electrolyte;  
electrochem element electrolyte acrylate crosslinked copolymer

IT Battery electrolytes  
(electrolytes contg. urethane acrylate-oxyalkylene acrylate  
crosslinked copolymer matrixes for secondary lithium  
batteries)

IT 14283-07-9, Lithium fluoroborate 90076-65-6  
444815-77-4 444815-78-5 444815-79-6  
RL: DEV (Device component use); USES (Uses)  
(electrolytes contg. urethane acrylate-oxyalkylene acrylate  
crosslinked copolymer matrixes for secondary lithium  
batteries)

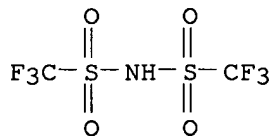
IT 14283-07-9, Lithium fluoroborate 90076-65-6  
RL: DEV (Device component use); USES (Uses)  
(electrolytes contg. urethane acrylate-oxyalkylene acrylate  
crosslinked copolymer matrixes for secondary lithium  
batteries)

RN 14283-07-9 HCAPLUS  
CN Borate(1-), tetrafluoro-, lithium (8CI, 9CI) (CA INDEX NAME)



Li<sup>+</sup>

RN 90076-65-6 HCAPLUS  
CN Methanesulfonamide, 1,1,1-trifluoro-N-[(trifluoromethyl)sulfonyl]-,  
lithium salt (9CI) (CA INDEX NAME)



● Li

L21 ANSWER 6 OF 44 HCAPLUS COPYRIGHT 2003 ACS  
AN 2002:276449 HCAPLUS  
DN 136:312572  
TI Solid polymer electrolytes using polyether poly  
(N-substituted urethane)  
IN Noh, Si-tae; Kweon, Jung-ohk; Choi, Hee Sung  
PA S. Korea

SO U.S. Pat. Appl. Publ., 13 pp.

CODEN: USXXCO

DT Patent

LA English

IC ICM H01M010-40

NCL 429314000

CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)

Section cross-reference(s): 38, 72, 76

FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	US 2002042002	A1	20020411	US 2001-968734	20011001
PRAI	KR 2000-57810	A	20001002		
	KR 2000-62811	A	20001025		

AB The present invention relates to a solid **polymer electrolyte** of polyether poly(N-substituted **urethane**) comprising an electrolytic compd. and a **polymer** matrix, wherein the **polymer** matrix is a copolymer comprising polyether unit and **polyurethane** unit and has 50,000-2,000,000 of a wt. av. mol. wt., where N-positions of the **polyurethane** unit are substituted with oligo(ethylene oxide) derivs. which provide flexibility and electrolytic conduction of the **polymer** matrix by controlling its length, compn., structure and **crosslinked** degree. Accordingly, the solid **polymer electrolyte** of the present invention provides excellent thermal stability, electrochem. stability and mech. properties and thus, is suitable for use in **polymer** secondary **batteries** and electrochem. devices.

ST **battery polymer electrolyte** polyether **polyurethane**; electrochem device **polymer electrolyte** polyether **polyurethane**

IT Ceramics

(filler; solid **polymer electrolytes** using polyether poly (N-substituted **urethane**))

IT Zeolites (synthetic), uses

RL: MOA (Modifier or additive use); USES (Uses)

(filler; solid **polymer electrolytes** using polyether poly (N-substituted **urethane**))

IT **Polyurethanes**, uses

RL: DEV (Device component use); USES (Uses)

(polyether-; solid **polymer electrolytes** using polyether poly (N-substituted **urethane**))

IT **Battery electrolytes**

Capacitors

Glass transition temperature

Ionic conductivity

**Polymer electrolytes**Secondary **batteries**

Sensors

(solid **polymer electrolytes** using polyether poly (N-substituted **urethane**))

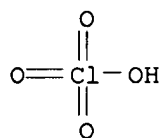
IT 1344-28-1, Alumina, uses 7631-86-9, Silica, uses 37220-89-6, **Lithium** aluminate

RL: MOA (Modifier or additive use); USES (Uses)

(filler; solid **polymer electrolytes** using polyether poly (N-substituted **urethane**))

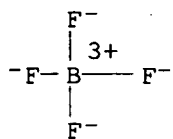
IT 9004-74-4P, **Polyethylene glycol** monomethyl etherRL: DEV (Device component use); **SPN (Synthetic preparation)**;**PREP (Preparation)**; USES (Uses)

- (polyether poly(N-substituted **urethane**) with; solid **polymer electrolytes** using polyether poly (N-substituted **urethane**))
- IT 816-43-3, **Lithium** diethylamide 865-47-4 1024-41-5, Benzyl tosylate 7782-89-0, **Lithium** amide 39794-77-9 68211-49-4, 1-Naphthyl tosylate 102242-35-3, 9-Anthryl tosylate  
 RL: CPS (Chemical process); PEP (Physical, engineering or chemical process); PROC (Process)
- (solid **polymer electrolytes** using polyether poly (N-substituted **urethane**))
- IT 96-48-0, .gamma.-Butyrolactone 96-49-1, Ethylene carbonate 108-32-7, Propylene carbonate 110-71-4 616-38-6, Dimethyl carbonate 623-53-0, Ethyl methyl carbonate 623-96-1, Dipropyl carbonate **7791-03-9**, **Lithium** perchlorate **14283-07-9**, **Lithium** tetrafluoroborate **21324-40-3**, **Lithium** hexafluorophosphate **33454-82-9**, **Lithium** triflate 73506-93-1, Diethoxyethane **90076-65-6**, **Lithium** bis(trifluoromethanesulfonyl)imide  
 RL: DEV (Device component use); USES (Uses)
- (solid **polymer electrolytes** using polyether poly (N-substituted **urethane**))
- IT 25036-33-3DP, N-Bu deriv. 25036-33-3DP, Ethylene glycol-bis(4-**isocyanatophenyl**)methane copolymer, N-Me deriv. 25036-33-3DP, reaction product of potassium tert-butanolate and **polyethylene glycol** ditosylate 25036-33-3DP, reaction product of tosyl heptaoxyethylene Me ether and oligooxyethylene ditosylate 25036-33-3DP, reaction product of tosyl trioxyethylene Me ether and oligooxyethylene ditosylate 93228-39-8DP, derivs.  
 RL: DEV (Device component use); **SPN (Synthetic preparation)**; **PREP (Preparation)**; USES (Uses)
- (solid **polymer electrolytes** using polyether poly (N-substituted **urethane**))
- IT **7791-03-9**, **Lithium** perchlorate **14283-07-9**, **Lithium** tetrafluoroborate **21324-40-3**, **Lithium** hexafluorophosphate **33454-82-9**, **Lithium** triflate **90076-65-6**, **Lithium** bis(trifluoromethanesulfonyl)imide  
 RL: DEV (Device component use); USES (Uses)
- (solid **polymer electrolytes** using polyether poly (N-substituted **urethane**))
- RN 7791-03-9 HCAPLUS  
 CN Perchloric acid, lithium salt (8CI, 9CI) (CA INDEX NAME)



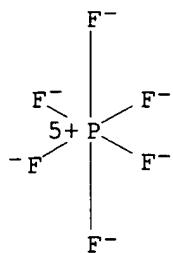
Li

- RN 14283-07-9 HCAPLUS  
 CN Borate(1-), tetrafluoro-, lithium (8CI, 9CI) (CA INDEX NAME)



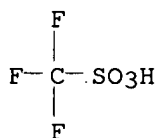
Li<sup>+</sup>

RN 21324-40-3 HCAPLUS  
CN Phosphate(1-), hexafluoro-, lithium (8CI, 9CI) (CA INDEX NAME)



Li<sup>+</sup>

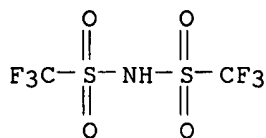
RN 33454-82-9 HCAPLUS  
CN Methanesulfonic acid, trifluoro-, lithium salt (8CI, 9CI) (CA INDEX NAME)



Li

RN 90076-65-6 HCAPLUS  
CN Methanesulfonamide, 1,1,1-trifluoro-N-[(trifluoromethyl)sulfonyl]-, lithium salt (9CI) (CA INDEX NAME)





● Li

L21 ANSWER 7 OF 44 HCAPLUS COPYRIGHT 2003 ACS  
 AN 2002:276448 HCAPLUS  
 DN 136:312571  
 TI **Lithium battery with polymeric electrolyte**  
 IN Lee, Jin-young  
 PA S. Korea  
 SO U.S. Pat. Appl. Publ., 8 pp.  
 CODEN: USXXCO  
 DT Patent  
 LA English  
 IC ICM H01M010-40  
 NCL 429314000  
 CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
 Section cross-reference(s): 38  
 FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	US 2002042001	A1	20020411	US 2001-961294	20010925
	CN 1345897	A	20020424	CN 2001-125708	20010820
	JP 2002187925	A2	20020705	JP 2001-301867	20010928
PRAI	KR 2000-57340	A	20000929		

AB A **polymeric electrolyte** and a **lithium battery** employing the same are disclosed. The **polymeric electrolyte** includes a **crosslinked polyether urethane** prepd. by reacting a **pre-polymer** having a **polyethylene oxide** backbone and terminated with **NCO**, with a **crosslinking agent**, **org. solvent** and **lithium salt**. Since the **polymeric electrolyte** is **electrochem. stable**, a **lithium battery** having improved reliability and safety can be obtained by employing the **polymeric electrolyte**.

ST **lithium battery polymer electrolyte**  
 ; **safety lithium battery polymer electrolyte**

IT Cycloalkanes

RL: RCT (Reactant); RACT (Reactant or reagent)  
 (bicyclic, heptane **triisocyanate** derivs.; **lithium battery with polymeric electrolyte**)

IT Bicyclic compounds

RL: RCT (Reactant); RACT (Reactant or reagent)  
 (cycloalkanes, heptane **triisocyanate** derivs.; **lithium battery with polymeric electrolyte**)

IT **Polyoxyalkylenes**, reactions

RL: RCT (Reactant); RACT (Reactant or reagent)

*applicant*

- (isocyanate-terminated; lithium battery with polymeric electrolyte)
- IT Battery electrolytes  
Polymer electrolytes  
(lithium battery with polymeric electrolyte)
- IT Polyoxyalkylenes, reactions  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(lithium battery with polymeric electrolyte)
- IT Polyoxyalkylenes, uses  
RL: DEV (Device component use); SPN (Synthetic preparation); PREP (Preparation); USES (Uses)  
(lithium complex; lithium battery with polymeric electrolyte)
- IT Secondary batteries  
(lithium; lithium battery with polymeric electrolyte)
- IT Polyurethanes, uses  
RL: DEV (Device component use); USES (Uses)  
(polyether-; lithium battery with polymeric electrolyte)
- IT 502-44-3, Caprolactone 7564-64-9, 3-Methyl-1,3,5-pentanetriol 25791-96-2 31694-55-0  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(crosslinking agent; lithium battery with polymeric electrolyte)
- IT 108-32-7, Propylene carbonate 7439-93-2, Lithium, uses 7791-03-9, Lithium perchlorate 9002-88-4, Polyethylene 9003-07-0, Polypropylene 12190-79-3, Cobalt lithium oxide colio2 14283-07-9, Lithium tetrafluoroborate 21324-40-3, Lithium hexafluorophosphate 33454-82-9, Lithium triflate 90076-65-6  
RL: DEV (Device component use); USES (Uses)  
(lithium battery with polymeric electrolyte)
- IT 7439-93-2DP, Lithium, polyethylene oxide complex 25322-68-3DP, Polyethylene glycol, lithium complex  
RL: DEV (Device component use); SPN (Synthetic preparation); PREP (Preparation); USES (Uses)  
(lithium battery with polymeric electrolyte)
- IT 96-49-1, Ethylene carbonate 105-58-8, Diethyl carbonate 616-38-6, Dimethyl carbonate 623-53-0, Ethyl methyl carbonate 872-36-6, Vinylene carbonate  
RL: DEV (Device component use); TEM (Technical or engineered material use); USES (Uses)  
(lithium battery with polymeric electrolyte)
- IT 56-87-1D, Lysine, esters triisocyanate derivs. 91-08-7, Tolyene 2,6-diisocyanate 101-68-8, Diphenylmethane 4,4'-diisocyanate 584-84-9, Tolyene 2,4-diisocyanate 822-06-0, Hexamethylene diisocyanate 4098-71-9, Isophorone diisocyanate 25322-68-3D, Peo, isocyanate-terminated 25322-69-4, Polypropylene glycol 26851-39-8 64743-80-2 70198-24-2

79371-37-2 132902-95-5

RL: RCT (Reactant); RACT (Reactant or reagent)

(lithium battery with polymeric electrolyte)

IT 7439-93-2, Lithium, uses 7791-03-9, Lithium perchlorate 12190-79-3, Cobalt lithium oxide colio2 14283-07-9, Lithium tetrafluoroborate 21324-40-3, Lithium hexafluorophosphate 33454-82-9, Lithium triflate 90076-65-6

RL: DEV (Device component use); USES (Uses)

(lithium battery with polymeric electrolyte)

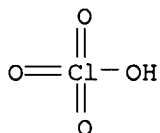
RN 7439-93-2 HCAPLUS

CN Lithium (7CI, 8CI, 9CI) (CA INDEX NAME)

Li

RN 7791-03-9 HCAPLUS

CN Perchloric acid, lithium salt (8CI, 9CI) (CA INDEX NAME)



Li

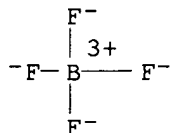
RN 12190-79-3 HCAPLUS

CN Cobalt lithium oxide (CoLiO2) (9CI) (CA INDEX NAME)

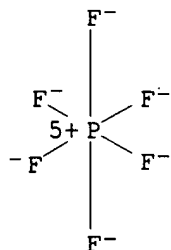
Component	Ratio	Component Registry Number
=====	=====	=====
O	2	17778-80-2
Co	1	7440-48-4
Li	1	7439-93-2

RN 14283-07-9 HCAPLUS

CN Borate(1-), tetrafluoro-, lithium (8CI, 9CI) (CA INDEX NAME)

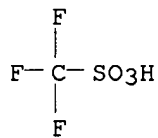
Li<sup>+</sup>

RN 21324-40-3 HCAPLUS  
 CN Phosphate(1-), hexafluoro-, lithium (8CI, 9CI) (CA INDEX NAME)



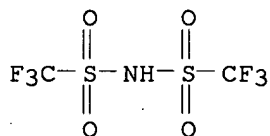
Li<sup>+</sup>

RN 33454-82-9 HCAPLUS  
 CN Methanesulfonic acid, trifluoro-, lithium salt (8CI, 9CI) (CA INDEX NAME)



Li

RN 90076-65-6 HCAPLUS  
 CN Methanesulfonamide, 1,1,1-trifluoro-N-[(trifluoromethyl)sulfonyl]-, lithium salt (9CI) (CA INDEX NAME)



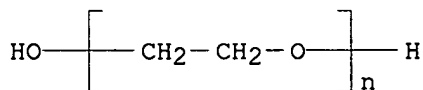
● Li

IT 7439-93-2DP, Lithium, polyethylene  
 oxide complex 25322-68-3DP, Polyethylene  
 glycol, lithium complex  
 RL: DEV (Device component use); SPN (Synthetic preparation);  
 PREP (Preparation); USES (Uses)  
 (lithium battery with polymeric  
 electrolyte)

RN 7439-93-2 HCAPLUS  
CN Lithium (7CI, 8CI, 9CI) (CA INDEX NAME)

Li

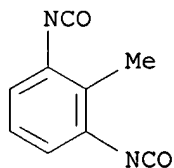
RN 25322-68-3 HCAPLUS  
CN Poly(oxy-1,2-ethanediyl), .alpha.-hydro-.omega.-hydroxy- (9CI) (CA INDEX NAME)



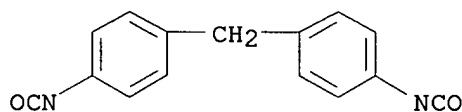
IT 91-08-7, Tolylene 2,6-diisocyanate 101-68-8,  
Diphenylmethane 4,4'-diisocyanate 584-84-9, Tolylene  
2,4-diisocyanate 822-06-0, Hexamethylene  
diisocyanate 4098-71-9, Isophorone diisocyanate  
25322-68-3D, Peo, isocyanate-terminated  
25322-69-4, Polypropylene glycol  
26851-39-8 64743-80-2 70198-24-2  
79371-37-2 132902-95-5

RL: RCT (Reactant); RACT (Reactant or reagent)  
(lithium battery with polymeric  
electrolyte)

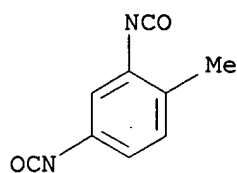
RN 91-08-7 HCAPLUS  
CN Benzene, 1,3-diisocyanato-2-methyl- (9CI) (CA INDEX NAME)



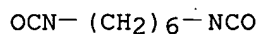
RN 101-68-8 HCAPLUS  
CN Benzene, 1,1'-methylenebis[4-isocyanato- (9CI) (CA INDEX NAME)



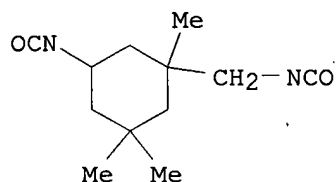
RN 584-84-9 HCAPLUS  
CN Benzene, 2,4-diisocyanato-1-methyl- (9CI) (CA INDEX NAME)



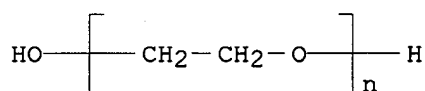
RN 822-06-0 HCAPLUS  
 CN Hexane, 1,6-diisocyanato- (9CI) (CA INDEX NAME)



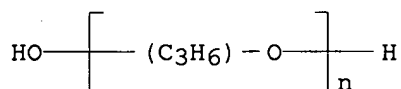
RN 4098-71-9 HCAPLUS  
 CN Cyclohexane, 5-isocyanato-1-(isocyanatomethyl)-1,3,3-trimethyl- (9CI) (CA INDEX NAME)



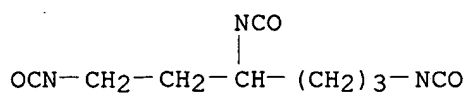
RN 25322-68-3 HCAPLUS  
 CN Poly(oxy-1,2-ethanediyl), .alpha.-hydro-.omega.-hydroxy- (9CI) (CA INDEX NAME)



RN 25322-69-4 HCAPLUS  
 CN Poly[oxy(methyl-1,2-ethanediyl)], .alpha.-hydro-.omega.-hydroxy- (9CI) (CA INDEX NAME)

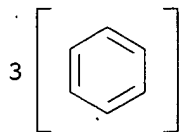


RN 26851-39-8 HCAPLUS  
 CN Hexane, 1,3,6-triisocyanato- (9CI) (CA INDEX NAME)

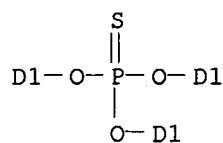


RN 64743-80-2 HCAPLUS

CN Phenol, isocyanato-, phosphorothioate (3:1) (ester) (9CI) (CA INDEX NAME)

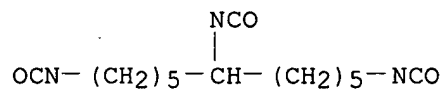


3 ( D1-NCO )



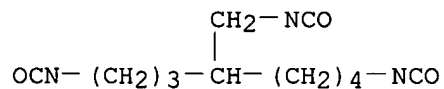
RN 70198-24-2 HCAPLUS

CN Undecane, 1,6,11-triisocyanato- (9CI) (CA INDEX NAME)



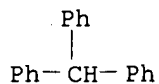
RN 79371-37-2 HCAPLUS

CN Octane, 1,8-diisocyanato-4-(isocyanatomethyl)- (9CI) (CA INDEX NAME)



RN 132902-95-5 HCAPLUS

CN Benzene, 1,1',1''-methylidynetris-, diisocyanato deriv. (9CI) (CA INDEX NAME)



2 ( D1-NCO )

L21 ANSWER 8 OF 44 HCAPLUS COPYRIGHT 2003 ACS

AN 2001:752025 HCAPLUS

KATHLEEN FULLER EIC 1700/PARKER LAW 308-4290

DN 135:273652  
 TI Preparations of gel **polymer solid electrolytes** with improved ionic conductivity and size stability  
 IN Zhang, Zhengcheng; Fang, Shibi; Li, Yongjun  
 PA Inst. of Chemistry, Chinese Academy of Sciences, Peop. Rep. China  
 SO Faming Zhuanli Shenqing Gongkai Shuomingshu, 8 pp.  
 CODEN: CNXXEV  
 DT Patent  
 LA Chinese  
 IC ICM C08L083-14  
 ICS C08K005-16; C08J003-24  
 CC 37-3 (Plastics Manufacture and Processing)  
 Section cross-reference(s): 76

FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	CN 1285375	A	20010228	CN 1999-111590	19990820
PRAI	CN 1999-111590		19990820		

AB The **electrolytes**, used to prepg. solid **electrolyte** film with 100-300 .mu.m thickness for **lithium** secondary **battery**, comprise: (A) a three dimensional network having internal plasticizing **polymer** segments, (B) a **Li** salt, and (C) a polar small mol. plasticizer, wherein A contains polymethylsiloxane or **polyoxyalkylene**, C is selected from ethylene carbonate, propylene carbonate and butyrolactone, and B is selected from LiClO<sub>4</sub>, LiPF<sub>6</sub> or LiN(CF<sub>3</sub>SO<sub>2</sub>)<sub>2</sub>. The electrolytes are prepd. by dissolving A, **crosslinking** agent contg. a **triisocyanate**, B and C in a ratio of 1:0.2:0.24-0.72:0.5-2.0 in anhyd. THF, mixing with 0.5% dibutyltin dilaurate at 75-95.degree. to obtain a viscous liq. followed by curing at 80.degree..

ST polymethylsiloxane **polyoxyalkylene** gel **polymer solid electrolyte** prepn; plasticizer **lithium** salt **polymer solid electrolyte** prepn; electrolyte film **lithium** secondary **battery**

IT Polysiloxanes, preparation  
 RL: IMF (Industrial manufacture); PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); PROC (Process); USES (Uses)  
 (polyoxyalkylene-polyurethane-; preps. of gel **polymer solid electrolytes** with improved ionic cond. and size stability)

IT Polyurethanes, preparation  
 RL: IMF (Industrial manufacture); PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); PROC (Process); USES (Uses)  
 (polyoxyalkylene-siloxane-; preps. of gel **polymer solid electrolytes** with improved ionic cond. and size stability)

IT Polyoxyalkylenes, preparation  
 RL: IMF (Industrial manufacture); PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); PROC (Process); USES (Uses)  
 (polyurethane-siloxane-; preps. of gel **polymer solid electrolytes** with improved ionic cond. and size stability)

IT Gelation  
 Plasticizers  
**Polymer electrolytes**



Solid **electrolytes**

Solid state secondary **batteries**

(prepns. of gel **polymer** solid **electrolytes** with improved ionic cond. and size stability)

IT 7791-03-9, **Lithium** perchlorate (LiClO<sub>4</sub>)

21324-40-3, **Lithium** hexafluorophosphate (LiPF<sub>6</sub>)

90076-65-6

RL: MOA (Modifier or additive use); USES (Uses)

(**electrolyte**; prepns. of gel **polymer** solid

**electrolytes** with improved ionic cond. and size stability)

IT 96-48-0, .gamma.-Butyrolactone 96-49-1, Ethylene carbonate 108-32-7, Propylene carbonate

RL: MOA (Modifier or additive use); USES (Uses)

(plasticizer; prepns. of gel **polymer** solid

**electrolytes** with improved ionic cond. and size stability)

IT 362600-41-7P

RL: **IMF** (**Industrial manufacture**); PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); **PREP** (**Preparation**); PROC (Process); USES (Uses)

(prepns. of gel **polymer** solid **electrolytes** with improved ionic cond. and size stability)

IT 7791-03-9, **Lithium** perchlorate (LiClO<sub>4</sub>)

21324-40-3, **Lithium** hexafluorophosphate (LiPF<sub>6</sub>)

90076-65-6

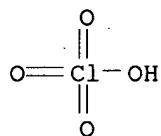
RL: MOA (Modifier or additive use); USES (Uses)

(**electrolyte**; prepns. of gel **polymer** solid

**electrolytes** with improved ionic cond. and size stability)

RN 7791-03-9 HCAPLUS

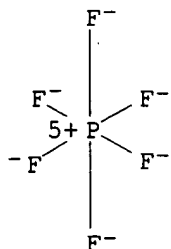
CN Perchloric acid, lithium salt (8CI, 9CI) (CA INDEX NAME)



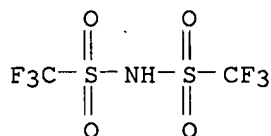
Li

RN 21324-40-3 HCAPLUS

CN Phosphate(1-), hexafluoro-, lithium (8CI, 9CI) (CA INDEX NAME)

Li<sup>+</sup>

RN 90076-65-6 HCAPLUS  
 CN Methanesulfonamide, 1,1,1-trifluoro-N-[(trifluoromethyl)sulfonyl]-,  
 lithium salt (9CI) (CA INDEX NAME)



● Li

L21 ANSWER 9 OF 44 HCAPLUS COPYRIGHT 2003 ACS  
 AN 2001:646112 HCAPLUS  
 DN 135:181627  
 TI Solid **polymeric electrolytes** containing network  
**polymers** and inorganic **lithium** salts for **lithium**  
 secondary **batteries** and their preparation  
 IN Zhang, Zhengcheng; Fan, Shibi; Li, Yongjun  
 PA Inst. of Chemistry, Chinese Academy of Sciences, Peop. Rep. China  
 SO Faming Zhuanli Shenqing Gongkai Shuomingshu, 8 pp.  
 CODEN: CNXXEV  
 DT Patent  
 LA Chinese  
 IC ICM C08L083-14  
 ICS C08L071-00; C08K003-10; H01M010-00  
 CC 38-3 (Plastics Fabrication and Uses)  
 Section cross-reference(s): 52, 76  
 FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	CN 1280149	A	20010117	CN 1999-109568	19990709
PRAI	CN 1999-109568		19990709		

AB The **electrolyte** comprises a network **polymer** prepd. by  
**crosslinking** a prepolymer with a **crosslinking** agent and  
 having a structure  $-\text{[Os}(\text{R}_1)(\text{CH}_3)]_n\text{[Os}(\text{R}_2)(\text{CH}_3)]_m-$ ; or  
 $\text{HO}(\text{CH}_2\text{CH}_2\text{O})_p\text{CH}_2\text{CH}(\text{R}_2)\text{CH}_2(\text{OCH}_2\text{CH}_2)_p\text{OH}$  ( $m + n = 100$ ;  $m = 10$  or  $20$ ;  $p = 4-13$ ;

R1 = **polyoxyethylene/polyoxypropylene** chain segment;  
 R2 = an internal plasticizing chain), and an inorg. **lithium** salt  
 such as LiClO<sub>4</sub> or LiN(CF<sub>3</sub>SO<sub>2</sub>)<sub>2</sub>. The presence of internal plasticizer  
 (such as **polyoxyethylene** allyl Me ether or **lithium**  
**polyoxyethylene** allyl ether sulfonate) pendant on the network  
 backbones can lower the glass transition temps. of the electrolytes, and  
 accelerate the migration of free **lithium** ions migration.

ST solid **polymer electrolyte lithium** secondary  
**battery**; polysiloxane **polyoxyalkylene**

**polyurethane** network **polymer electrolyte**;  
 ionic cond polysiloxane **polyoxyalkylene** electrolyte network

IT Polysiloxanes, uses

RL: DEV (Device component use); IMF (Industrial manufacture);  
 POF (Polymer in formulation); PREP (Preparation); USES (Uses)  
 (Me, reaction products with **polyoxyethylene** allyl Me ether,  
 ethylene oxide-propylene oxide copolymer and **triisocyanates**;  
 solid **polymeric electrolytes** contg. network  
**polymers** and inorg. **lithium** salts for **lithium**  
 secondary **batteries**)

IT Secondary **batteries**

(**lithium**; solid **polymeric electrolytes**  
 contg. network **polymers** and inorg. **lithium** salts  
 for **lithium** secondary **batteries**)

IT Polysiloxanes, uses

RL: DEV (Device component use); IMF (Industrial manufacture);  
 POF (Polymer in formulation); PREP (Preparation); USES (Uses)  
 (**polyoxyalkylene-polyurethane-**; solid  
**polymeric electrolytes** contg. network  
**polymers** and inorg. **lithium** salts for **lithium**  
 secondary **batteries**)

IT **Polyurethanes**, uses

RL: DEV (Device component use); IMF (Industrial manufacture);  
 POF (Polymer in formulation); PREP (Preparation); USES (Uses)  
 (**polyoxyalkylene-siloxane-**; solid **polymeric**  
**electrolytes** contg. network **polymers** and inorg.  
**lithium** salts for **lithium** secondary **batteries**  
 )

IT **Polyoxyalkylenes**, uses

RL: DEV (Device component use); IMF (Industrial manufacture);  
 POF (Polymer in formulation); PREP (Preparation); USES (Uses)  
 (**polyurethane-siloxane-**; solid **polymeric**  
**electrolytes** contg. network **polymers** and inorg.  
**lithium** salts for **lithium** secondary **batteries**  
 )

IT Ionic conductivity

**Polymer electrolytes**

**Polymer networks**

Solid **electrolytes**

(solid **polymeric electrolytes** contg. network  
**polymers** and inorg. **lithium** salts for **lithium**  
 secondary **batteries**)

IT 9003-11-6DP, Ethylene oxide-propylene oxide copolymer, reaction products  
 with siloxanes and **triisocyanates** 27252-80-8DP,  
**Polyoxyethylene** allyl methyl ether, reaction products with Me  
 siloxanes, ethylene oxide-propylene oxide copolymer and  
**triisocyanates** 28805-80-3DP, reaction products with  
**polyoxyalkylene-polysiloxanes** 354818-56-7DP, reaction products  
 with Me siloxanes, ethylene oxide-propylene oxide copolymer and

**triisocyanates**

RL: DEV (Device component use); IMF (Industrial manufacture);  
POF (Polymer in formulation); PREP (Preparation); USES (Uses)

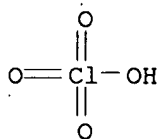
(solid **polymeric electrolytes** contg. network  
**polymers** and inorg. lithium salts for lithium  
secondary **batteries**)

IT 7791-03-9, Lithium perchlorate 90076-65-6,  
Lithium bis(trifluoromethylsulfonyl) imide  
RL: MOA (Modifier or additive use); USES (Uses)  
(solid **polymeric electrolytes** contg. network  
**polymers** and inorg. lithium salts for lithium  
secondary **batteries**)

IT 7791-03-9, Lithium perchlorate 90076-65-6,  
Lithium bis(trifluoromethylsulfonyl) imide  
RL: MOA (Modifier or additive use); USES (Uses)  
(solid **polymeric electrolytes** contg. network  
**polymers** and inorg. lithium salts for lithium  
secondary **batteries**)

RN 7791-03-9 HCAPLUS

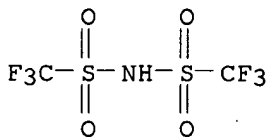
CN Perchloric acid, lithium salt (8CI, 9CI) (CA INDEX NAME)



Li

RN 90076-65-6 HCAPLUS

CN Methanesulfonamide, 1,1,1-trifluoro-N-[(trifluoromethyl)sulfonyl]-,  
lithium salt (9CI) (CA INDEX NAME)



● Li

L21 ANSWER 10 OF 44 HCAPLUS COPYRIGHT 2003 ACS

AN 2001:98726 HCAPLUS

DN 134:150055

TI **Polymer solid electrolytes** containing **urethane**  
(meth)acrylates and electrochemical devices, e.g. secondary  
**batteries**, therefrom

IN Saito, Takaituro; Nishimura, Takuaki

PA Nippon Synthetic Chemical Industry Co., Ltd., Japan

SO Jpn. Kokai Tokkyo Koho, 9 pp.  
 CODEN: JKXXAF  
 DT Patent  
 LA Japanese  
 IC ICM H01B001-06  
 ICS C08F290-06; H01G009-038; H01M006-18; H01M010-40  
 CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
 Section cross-reference(s): 38, 76

FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	JP 2001035251	A2	20010209	JP 1999-205791	19990721
PRAI	JP 1999-205791		19990721		
AB	The electrolyte comprises a <b>crosslinked polyurethane</b> acrylate matrix and an electrolyte salt. Electrochem. devices and secondary <b>batteries</b> comprising of the above stated electrolytes are also claimed.				
ST	solid <b>polymer electrolyte</b> electrochem device; secondary <b>battery</b> electrolyte <b>crosslinked polyurethane</b> acrylate; <b>polyoxyalkylene polyurethane</b> acrylate solid electrolyte; <b>polyethylene oxide polyurethane</b> acrylate solid electrolyte; polypropylene oxide <b>polyurethane</b> acrylate solid electrolyte				
IT	<b>Battery</b> electrolytes <b>Polymer electrolytes</b> (crosslinked <b>polyurethane</b> acrylates as solid electrolytes for secondary <b>batteries</b> )				
IT	Electric apparatus (electrochem., electrolytes; <b>crosslinked polyurethane</b> acrylates as solid electrolytes for secondary <b>batteries</b> )				
IT	<b>Polyurethanes</b> , uses RL: DEV (Device component use); TEM (Technical or engineered material use); USES (Uses) (polyester-, acrylic; <b>crosslinked polyurethane</b> acrylates as solid electrolytes for secondary <b>batteries</b> )				
IT	<b>Polyurethanes</b> , uses RL: DEV (Device component use); TEM (Technical or engineered material use); USES (Uses) (polyoxyalkylene-, acrylic; <b>crosslinked polyurethane</b> acrylates as solid electrolytes for secondary <b>batteries</b> )				
IT	<b>7439-93-2DP, Lithium</b> , complexes with <b>crosslinked polyurethane</b> acrylates, uses 324018-28-2DP, <b>lithium</b> complex 324018-29-3DP, <b>lithium</b> complex 324018-30-6DP, <b>lithium</b> complex 324018-31-7DP, <b>lithium</b> complex 324018-32-8DP, <b>lithium</b> complex 324018-33-9DP, <b>lithium</b> complex 324018-34-0DP, <b>lithium</b> complex 324018-35-1DP, <b>lithium</b> complex 324018-36-2DP, <b>lithium</b> salt 324018-37-3DP, <b>lithium</b> salt RL: DEV (Device component use); IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses) (crosslinked <b>polyurethane</b> acrylates as solid electrolytes for secondary <b>batteries</b> )				
IT	<b>7439-93-2DP, Lithium</b> , complexes with <b>crosslinked polyurethane</b> acrylates, uses RL: DEV (Device component use); IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation);				

## USES (Uses)

(**crosslinked polyurethane** acrylates as solid electrolytes for secondary **batteries**)

RN 7439-93-2 HCAPLUS

CN Lithium (7CI, 8CI, 9CI) (CA INDEX NAME)

Li

L21 ANSWER 11 OF 44 HCAPLUS COPYRIGHT 2003 ACS

AN 2000:810251 HCAPLUS

DN 134:281350

TI Electrochemical characterization of **polymer electrolytes** based on polyether/hydroxyethylcellulose

AU Regiani, Anelise M.; Pawlicka, Agnieszka; Curvelo, A. Aprigio S.; Gandini, Alessandro; LeNest, Jean-Francois

CS Instituto de Quimica de Sao Carlos - USP; Av. Dr. Carlos Botelho, Sao Carlos, 13560970, Brazil

SO Natural Polymers and Composites, [Proceedings from the Third International Symposium on Natural Polymers and Composites, [and the] Workshop on Progress in Production and Processing of Cellulosic Fibres and Natural Polymers], Sao Pedro, Brazil, May 14-17, 2000 (2000), 146-150. Editor(s): Capparelli Mattoso, Luiz Henrique; Leao, Alcides; Frollini, Elisabete. Publisher: Embrapa Instrumentacao Agropecuaria, Sao Carlos, Brazil. CODEN: 69AHKY

DT Conference

LA English

CC 36-5 (Physical Properties of Synthetic High Polymers)  
Section cross-reference(s): 43, 76

AB The ionic cond. of various solid electrolytes based on hydroxyethylcellulose (HEC) grafted or **crosslinked** with oligoether **diisocyanates** was investigated. The mechanism ruling the ionic conduction followed a free-vol. theory represented by the William Landel Ferry (WLF) model, typical for amorphous electrolytes. The cond. in these films is independent of the HEC structural parameters. The actual values of cond. measured at ambient temp. suggest that the electrolytes described here could be used as an alternative to the corresponding networks based on poly(ethylene oxide) alone.

ST hydroxyethylcellulose polyether electrolyte ionic cond

IT **Polyoxyalkylenes**, properties

RL: POF (Polymer in formulation); PRP (Properties); **SPN (Synthetic preparation)**; **PREP (Preparation)**; USES (Uses)

(**diisocyanate** derives., **polymers** with hydroxyethylcellulose, LiClO<sub>4</sub>-doped; electrochem. characterization of **polymer electrolytes** based on polyether/hydroxyethylcellulose)

IT Glass transition temperature

Ionic conductivity

Polyelectrolytes

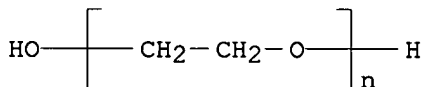
(electrochem. characterization of **polymer electrolytes** based on polyether/hydroxyethylcellulose)

IT **Polyurethanes**, properties

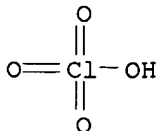
RL: PRP (Properties); **SPN (Synthetic preparation)**; **PREP (Preparation)**

(**polyoxyalkylene**-; electrochem. characterization of **polymer electrolytes** based on

polyether/hydroxyethylcellulose)  
 IT 9004-62-ODP, Cellosize QP 09H, **polymers** with poly(ethylene oxide) **diisocyanate** derivs. 25322-68-3DP, **Polyethylene oxide, diisocyanate** derives., **polymers** with hydroxyethylcellulose  
 RL: POF (Polymer in formulation); PRP (Properties); SPN (Synthetic preparation); PREP (Preparation); USES (Uses)  
 (LiClO<sub>4</sub>-doped; electrochem. characterization of **polymer electrolytes** based on polyether/hydroxyethylcellulose)  
 IT 7791-03-9, **Lithium perchlorate**  
 RL: MOA (Modifier or additive use); USES (Uses)  
 (dopant; electrochem. characterization of **polymer electrolytes** based on polyether/hydroxyethylcellulose)  
 RE.CNT 8 THERE ARE 8 CITED REFERENCES AVAILABLE FOR THIS RECORD  
 RE  
 (1) LeNest, J; British Polymer Journal 1988, V20, P253 HCAPLUS  
 (2) LeNest, J; Electrochimica Acta 1992, V37(i.9), P1585  
 (3) LeNest, J; Polymer Bulletin 1991, V25, P443  
 (4) Le Nest, J; Trip 1994, V2(i.12), P432  
 (5) Regiani, A; Polimeros: Ciencia e tecnologia 1999, V9, P45 HCAPLUS  
 (6) Regiani, A; to be published in Polymer international  
 (7) Schoenenberger, C; Electrochimica acta 1995, V40(i.13-14), P2281  
 (8) Velasquez-Morales, P; Electrochimica Acta 1998, V43(i.10-11), P1275  
 IT 25322-68-3DP, **Polyethylene oxide, diisocyanate** derives., **polymers** with hydroxyethylcellulose  
 RL: POF (Polymer in formulation); PRP (Properties); SPN (Synthetic preparation); PREP (Preparation); USES (Uses)  
 (LiClO<sub>4</sub>-doped; electrochem. characterization of **polymer electrolytes** based on polyether/hydroxyethylcellulose)  
 RN 25322-68-3 HCAPLUS  
 CN Poly(oxy-1,2-ethanediyl), .alpha.-hydro-.omega.-hydroxy- (9CI) (CA INDEX NAME)



IT 7791-03-9, **Lithium perchlorate**  
 RL: MOA (Modifier or additive use); USES (Uses)  
 (dopant; electrochem. characterization of **polymer electrolytes** based on polyether/hydroxyethylcellulose)  
 RN 7791-03-9 HCAPLUS  
 CN Perchloric acid, lithium salt (8CI, 9CI) (CA INDEX NAME)



Li

L21 ANSWER 12 OF 44 HCAPLUS COPYRIGHT 2003 ACS

AN 2000:688306 HCAPLUS

DN 133:282489

TI Compositions of ionically conductive solid polymers, ionically conductive solid polyelectrolytes, binder resins and their use in secondary **batteries**

IN Hata, Kimiyo; Sato, Takaya

PA Nisshinbo Industries, Inc., Japan

SO PCT Int. Appl., 59 pp.

CODEN: PIXXD2

DT Patent

LA Japanese

IC ICM C08L029-04

ICS C08F008-00; C08K003-00; H01B001-06; H01M010-40; H01M004-62; H01M004-04

CC 37-3 (Plastics Manufacture and Processing)

Section cross-reference(s): 52

FAN.CNT 3

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	WO 2000056815	A1	20000928	WO 2000-JP1734	20000322
	W: CA, CN, JP, KR, SG, US				
	RW: AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE				
	CA 2333277	AA	20000928	CA 2000-2333277	20000322
	EP 1090956	A1	20010411	EP 2000-911270	20000322
	R: AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LI, LU, NL, SE, MC, PT, IE, FI				
	US 6537468	B1	20030325	US 2000-700912	20001121
PRAI	JP 1999-78087	A	19990323		
	WO 2000-JP1734	W	20000322		
AB	The comps. contain (A) polymers having high cond., adhesive strength and shape retention property, (B) ionically conductive salts and (C) <b>crosslinkable</b> compds. and are used as solid polyelectrolytes and binders for secondary <b>batteries</b> where the polymers are polyvinyl alc. type compds. which bear oxyalkylene groups. Thus, mixing a soln. of a poly(vinyl alc.) (Mw 500, sapon. degree >98%) 10 in acetone 70 with a soln. of NaOH 1.81 in water 2.5 at room temp. for 1 h, combining the resulting mixt. with a soln. of glycidol 67 in acetone 100 parts over 3 h, stirring for 8 h at 50.degree. and working up gave a dihydroxypropylated poly(vinyl alc.) with substitution degree of 0.74, which was cyanoethylated with acrylonitrile to give a polymer deriv. (A). Dissolving the A with Li perchlorate (I) in THF, evapg. the solvent, mixing 1 part the resulting composite with 0.2 parts <b>polyethylene glycol</b> dimethacrylate and 0.2 parts methoxypolyethylene glycol monomethacrylate and AIBN so that a conductive solid polymer compn. with adjusted I content of 1 mol/kg-compn. could be reached, and heating the compn. between 2 Cu panels at 100.degree. for 1 h gave a 200-.mu.m film with elec. cond. $4.2 \times 10^{-4}$ S/cm, adhesive strength 0.8 kN/m, amorphous polymer phase, solid state at room temp. and wt. loss <0.15%.				
ST	secondary <b>battery</b> solid polyelectrolyte polyvinyl alc dihydroxypropylated deriv compn; <b>polyethylene glycol</b> dimethacrylate <b>crosslinker</b> <b>polymer electrolyte</b>				
IT	Binders <b>Electrolytes</b>				



Solid state secondary **batteries**

(compsn. of ionically conductive solid **polymers**, ionically conductive solid polyelectrolytes, binder resins and use in secondary **batteries**)

IT Polymer blends

RL: POF (Polymer in formulation); PRP (Properties); TEM (Technical or engineered material use); USES (Uses)

(semi-interpenetrating network; comps. of ionically conductive solid polymers, ionically conductive solid polyelectrolytes, binder resins and use in secondary **batteries**)

IT. **Polyurethanes**, preparation

RL: **IMF (Industrial manufacture)**; POF (Polymer in formulation);

PRP (Properties); TEM (Technical or engineered material use); **PREP**

(**Preparation**); USES (Uses)

(semi-interpenetrating networks with poly(vinyl alc.) derivs.; comps. of ionically conductive solid polymers, ionically conductive solid polyelectrolytes, binder resins and use in secondary **batteries**)

IT 54140-67-9, Denacol EX 145

RL: MOA (Modifier or additive use); USES (Uses)

(branching agent; comps. of ionically conductive solid polymers, ionically conductive solid polyelectrolytes, binder resins and use in secondary **batteries**)

IT 9003-20-7DP, Poly(vinyl acetate), partially saponified, oxyalkylated, reaction products with acrylonitrile 25067-34-9DP, Ethylene-vinyl alcohol copolymer, oxyalkylated, reaction products with acrylonitrile

RL: **IMF (Industrial manufacture)**; POF (Polymer in formulation);

PRP (Properties); TEM (Technical or engineered material use); **PREP**

(**Preparation**); USES (Uses)

(comps. of ionically conductive solid polymers, ionically conductive solid polyelectrolytes, binder resins and use in secondary **batteries**)

IT 107-13-1, Acrylonitrile, uses

RL: MOA (Modifier or additive use); USES (Uses)

(cyanoethylation agent; comps. of ionically conductive solid polymers, ionically conductive solid polyelectrolytes, binder resins and use in secondary **batteries**)

IT 556-52-5, Glycidol

RL: MOA (Modifier or additive use); USES (Uses)

(dihydroxypropylation agent; comps. of ionically conductive solid polymers, ionically conductive solid polyelectrolytes, binder resins and use in secondary **batteries**)

IT **7791-03-9, Lithium perchlorate**

RL: TEM (Technical or engineered material use); USES (Uses)

(**electrolytes**; comps. of ionically conductive solid **polymers**, ionically conductive solid polyelectrolytes, binder resins and use in secondary **batteries**)

IT 75-56-9, Propylene oxide, uses

RL: MOA (Modifier or additive use); USES (Uses)

(hydroxypropylation agent; comps. of ionically conductive solid polymers, ionically conductive solid polyelectrolytes, binder resins and use in secondary **batteries**)

IT 9002-89-5DP, Poly(vinyl alcohol), oxyalkylated, reaction products with acrylonitrile

RL: **IMF (Industrial manufacture)**; POF (Polymer in formulation);

PRP (Properties); TEM (Technical or engineered material use); **PREP**

(**Preparation**); USES (Uses)

(semi-interpenetrating networks with **crosslinked** polymers;

comps. of ionically conductive solid polymers, ionically conductive solid polyelectrolytes, binder resins and use in secondary **batteries**)

IT 31694-55-ODP, **Polyethylene glycol** glycerol ether, **polyurethanes** 108927-94-2P, Methoxypolyethylene glycol monomethacrylate-**polyethylene glycol** dimethacrylate copolymer

RL: **IMF (Industrial manufacture)**; POF (Polymer in formulation); PRP (Properties); TEM (Technical or engineered material use); **PREP (Preparation)**; USES (Uses)

(semi-interpenetrating networks with poly(vinyl alc.) derivs.; comps. of ionically conductive solid polymers, ionically conductive solid polyelectrolytes, binder resins and use in secondary **batteries**)

RE.CNT 9 THERE ARE 9 CITED REFERENCES AVAILABLE FOR THIS RECORD  
RE

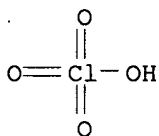
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IT 7791-03-9, **Lithium perchlorate**

RL: TEM (Technical or engineered material use); USES (Uses)  
(**electrolytes**; comps. of ionically conductive solid **polymers**, ionically conductive solid polyelectrolytes, binder resins and use in secondary **batteries**)

RN 7791-03-9 HCAPLUS

CN Perchloric acid, lithium salt (8CI, 9CI) (CA INDEX NAME)



● Li

L21 ANSWER 13 OF 44 HCAPLUS COPYRIGHT 2003 ACS

AN 2000:520356 HCAPLUS

DN 133:208603

TI Ionic conductivity and physical stability study of gel network **polymer electrolytes**

AU Zhang, Zhengcheng; Fang, Shibi

CS Institute of Chemistry, Chinese Academy of Sciences, Beijing, 100080, Peop. Rep. China

SO Journal of Applied Polymer Science (2000), 77(13), 2957-2962

CODEN: JAPNAB; ISSN: 0021-8995

PB John Wiley & Sons, Inc.

DT Journal

- LA English  
 CC 37-5 (Plastics Manufacture and Processing)  
 Section cross-reference(s): 76
- AB Gel **polymer electrolytes** (GPE) were prepd. by **crosslinking** between poly(ethylene glycol) and a **crosslinking** agent with three **isocyanate** groups in the presence of propylene carbonate (PC) and ethylene carbonate (EC) or their mixt., and their ionic cond. was measured. When the plasticizer amt. was fixed, the ionic cond. was greatly influenced by the nature of plasticizer. The cond. data followed the Arrhenius equation. Whatever plasticizer was used, max. ambient cond. was found at a salt concn. ratio  $[Li+]/[EO]$  equal to 0.20. The phys. stability of the GPEs was studied qual. by wt. loss under pressure. The stability was greatly affected by the network structure and the most stable was the GPE contg. the PEO1000 segment, which has a strong interaction between network and plasticizer.
- ST **polyethylene glycol isocyanate crosslinking** electrolyte gel prepn; plasticizer PEO gel electrolyte cond network structure
- IT **Crosslinking**  
 Gels  
 Ionic conductivity  
 Plasticizers  
     **Polymer electrolytes**  
     **Polymer networks**  
       (effect of plasticizer on ionic cond. and stability of PEO-based **polyurethane/lithium perchlorate gel electrolytes**)
- IT **Polyurethanes**, preparation  
 RL: PRP (Properties); **SPN (Synthetic preparation); PREP (Preparation)**  
     (polyether-; effect of plasticizer on ionic cond. and stability of PEO-based **polyurethane/lithium perchlorate gel electrolytes**)
- IT **7791-03-9, Lithium perchlorate**  
 RL: PRP (Properties)  
     (effect of plasticizer on ionic cond. and stability of PEO-based **polyurethane/lithium perchlorate gel electrolytes**)
- IT **7439-93-2DP, Lithium, PEO-trimethylolpropane-TDI polyurethane complexes**, preparation 88842-46-0DP, **lithium complexes**.  
 RL: PRP (Properties); **SPN (Synthetic preparation); PREP (Preparation)**  
     (effect of plasticizer on ionic cond. and stability of PEO-based **polyurethane/lithium perchlorate gel electrolytes**)
- IT 77-99-6, 1,1,1-Tri(hydroxymethyl)propane **584-84-9**, Toluene-2,4-**diisocyanate**  
 RL: RCT (Reactant); RACT (Reactant or reagent)  
     (effect of plasticizer on ionic cond. and stability of PEO-based **polyurethane/lithium perchlorate gel electrolytes**)
- IT 68-12-2, DMF, uses 96-48-0, .gamma.-Butyrolactone 96-49-1, Ethylene carbonate 108-32-7, Propylene carbonate 513-85-9, Dimethyl ethylene glycol 24471-99-6, Diethylene orthocarbonate  
 RL: MOA (Modifier or additive use); USES (Uses)  
     (plasticizer; effect of plasticizer on ionic cond. and stability of PEO-based **polyurethane/lithium perchlorate gel electrolytes**)
- RE.CNT 9 THERE ARE 9 CITED REFERENCES AVAILABLE FOR THIS RECORD

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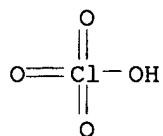
IT 7791-03-9, Lithium perchlorate

RL: PRP (Properties)

(effect of plasticizer on ionic cond. and stability of PEO-based  
polyurethane/lithium perchlorate gel electrolytes)

RN 7791-03-9 HCAPLUS

CN Perchloric acid, lithium salt (8CI, 9CI) (CA INDEX NAME)



Li

IT 7439-93-2DP, Lithium, PEO-trimethylolpropane-TDI

polyurethane complexes, preparation

RL: PRP (Properties); SPN (Synthetic preparation); PREP  
(Preparation)

(effect of plasticizer on ionic cond. and stability of PEO-based  
polyurethane/lithium perchlorate gel electrolytes)

RN 7439-93-2 HCAPLUS

CN Lithium (7CI, 8CI, 9CI) (CA INDEX NAME)

Li

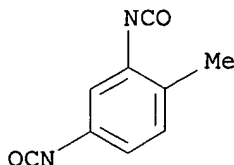
IT 584-84-9, Toluene-2,4-diisocyanate

RL: RCT (Reactant); RACT (Reactant or reagent)

(effect of plasticizer on ionic cond. and stability of PEO-based  
polyurethane/lithium perchlorate gel electrolytes)

RN 584-84-9 HCAPLUS

CN Benzene, 2,4-diisocyanato-1-methyl- (9CI) (CA INDEX NAME)



L21 ANSWER 14 OF 44 HCAPLUS COPYRIGHT 2003 ACS

AN 2000:520275 HCAPLUS

DN 133:223128

TI **Polymer electrolytes** based on **lithium**

sulfonate derived from perfluorovinyl ethers; single ion conductors

AU Bayoudh, Sami; Parizel, Nathalie; Reibel, Leonard

CS CNRS Institut Charles Sadron, Strasbourg, 67083, Fr.

SO Polymer International (2000), 49(7), 703-711

CODEN: PLYIEI; ISSN: 0959-8103

PB John Wiley &amp; Sons Ltd.

DT Journal

LA English

CC 35-7 (Chemistry of Synthetic High Polymers)

Section cross-reference(s): 36, 76

AB A **lithium** perfluoroalkyl sulfonate was synthesized from a com.

perfluorovinyl ether fitted with a fluorosulfonyl group. By making use of the vinyl ether group, this species was incorporated into

**polyurethane** networks based either on a poly(ethylene oxide)glycol or on a tri-arm star poly(ethylene oxide) triol. The ionic cond., thermal properties, and morphol. domains of rigidity (solid-state <sup>1</sup>H NMR),were measured for the single cation conductor **polymer****electrolytes**. When compared to the **polymer****electrolytes** where the same but untethered **lithium**perfluoroalkyl sulfonate is dissolved in the same initial networks, a loss of cond. was obsd. despite the higher mobility of the ionomers. This loss corresponds to the cond. attributed to the anionic species. The higher mobility of the ionomeric electrolytes is to be related to the quasi absence of phys. **crosslinks**.ST **lithium** perfluoroalkylsulfonate vinyl ether **polyurethane**network prep. cond.; **polyethylene oxide** based**polyurethane** electrolyte **lithium** fluoroalkylsulfonate;ionic cond. morphol. **lithium** fluoroalkylsulfonate**polyurethane** networkIT **Polyurethanes**, preparation**Polyurethanes**, preparation

RL: PRP (Properties); SPN (Synthetic preparation); PREP

(Preparation)

(polyether-, fluorine-contg.; prep. and morphol. and single ion cond. of **lithium** sulfonate perfluorovinyl ether**polyurethane** electrolyte networks based on linear and star poly(ethylene oxide)s)

IT Fluoropolymers, preparation

RL: PRP (Properties); SPN (Synthetic preparation); PREP

(Preparation)

(polyether-**polyurethane**-, fluorine-contg.; prep. and morphol. and single ion cond. of **lithium** sulfonate perfluorovinyl ether**polyurethane** electrolyte networks based on linear and star poly(ethylene oxide)s)

IT Polyethers, preparation

RL: PRP (Properties); SPN (Synthetic preparation); PREP

(Preparation)

(polyurethane-, fluorine-contg.; prep. and morphol. and single ion cond. of **lithium** sulfonate perfluorovinyl ether**polyurethane** electrolyte networks based on linear and star poly(ethylene oxide)s)

IT Glass transition temperature

Ionic conductivity

**Polymer electrolytes****Polymer morphology****Polymer networks**

(prepn. and morphol. and single ion cond. of **lithium**  
sulfonate perfluorovinyl ether **polyurethane**  
**electrolyte** networks based on linear and star poly(ethylene  
oxide)s)

IT Ionomers

RL: PRP (Properties); **SPN (Synthetic preparation); PREP**  
**(Preparation)**

(prepn. and morphol. and single ion cond. of **lithium**  
sulfonate perfluorovinyl ether **polyurethane** electrolyte  
networks based on linear and star poly(ethylene oxide)s)

IT 214690-38-7P, **Lithium** perfluoro-3,6-dioxa-4-methyl-.DELTA.7-  
octylsulfonate

RL: RCT (Reactant); **SPN (Synthetic preparation); PREP**  
**(Preparation); RACT (Reactant or reagent)**

(intermediate; prepn. and morphol. and single ion cond. of  
**lithium** sulfonate perfluorovinyl ether **polyurethane**  
electrolyte networks based on linear and star poly(ethylene oxide)s)

IT 291276-47-6P

RL: RCT (Reactant); **SPN (Synthetic preparation); PREP**  
**(Preparation); RACT (Reactant or reagent)**

(monomer; prepn. and morphol. and single ion cond. of **lithium**  
sulfonate perfluorovinyl ether **polyurethane** electrolyte  
networks based on linear and star poly(ethylene oxide)s)

IT 291276-48-7P 291276-50-1P 291276-52-3P 291276-53-4P 291276-54-5P  
291276-55-6P

RL: PRP (Properties); RCT (Reactant); **SPN (Synthetic preparation)**  
**; PREP (Preparation); RACT (Reactant or reagent)**

(prepn. and morphol. and single ion cond. of **lithium**  
sulfonate perfluorovinyl ether **polyurethane** electrolyte  
networks based on linear and star poly(ethylene oxide)s)

IT 291276-49-8P 291276-51-2DP, **lithium** salts

RL: PRP (Properties); **SPN (Synthetic preparation); PREP**  
**(Preparation)**

(prepn. and morphol. and single ion cond. of **lithium**  
sulfonate perfluorovinyl ether **polyurethane** electrolyte  
networks based on linear and star poly(ethylene oxide)s)

IT 60-24-2, Mercaptoethanol 1310-65-2, **Lithium** hydroxide  
16090-14-5, Perfluoro-3,6-dioxa-4-methyl-.DELTA.7-octylsulfonyl fluoride  
50586-59-9, Trimethylolpropane **polyethylene glycol**  
ether

RL: RCT (Reactant); RACT (Reactant or reagent)

(prepn. and morphol. and single ion cond. of **lithium**  
sulfonate perfluorovinyl ether **polyurethane** electrolyte  
networks based on linear and star poly(ethylene oxide)s)

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L21 ANSWER 15 OF 44 HCAPLUS COPYRIGHT 2003 ACS

AN 1999:805535 HCAPLUS

DN 132:139705

TI Synthesis and characterization of polyether **urethane** acrylate-LiCF<sub>3</sub>SO<sub>3</sub>-based **polymer electrolytes** by UV-curing in **lithium batteries**

AU Kim, C.-S.; Kim, B.-H.; Kim, K.

CS Sungbuk-ku, 1 Anam-dong, Department of Chemistry, Korea University, Seoul, S. Korea

SO Journal of Power Sources (1999), 84(1), 12-23

CODEN: JPSODZ; ISSN: 0378-7753

PB Elsevier Science S.A.

DT Journal

LA English

CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
Section cross-reference(s): 36, 38

AB The prepolymers of polyether **urethane** acrylate (PEUA) were synthesized from polyether polyol (**polyethylene glycol** (PEG) or **polypropylene glycol** (PPG)), **diisocyanate** (hexamethylene **diisocyanate** (HMDI) or toluene 2,4-**diisocyanate** (TDI)), and the caprolactone-modified hydroxyethyl acrylate (FA2D) using the catalyst (dibutyltin dilaurate (DBTDL)) by stepwise addn. reaction. LiCF<sub>3</sub>SO<sub>3</sub> was dissolved in PEUA prepolymers, and plasticizer (propylene carbonate (PC)) was added into prepolymer and salt mixts. Then photoinitiator (Irgacure 184) was also dissolved in the mixts. Thin films were prepd. by casting on the glass plate, and then by curing the plasticized prepolymer and salt mixts. under UV radiation. Electrochem. and elec. properties of PEUA-LiCF<sub>3</sub>SO<sub>3</sub>-based

- polymer electrolytes** were evaluated and discussed to be used in **lithium batteries**.
- ST **lithium battery polymer electrolyte**  
; polyether urethane acrylate lithium triflate electrolyte
- IT Transference number  
(**lithium**; synthesis and characterization of polyether urethane acrylate-LiCF<sub>3</sub>SO<sub>3</sub>-based **polymer electrolytes** by UV-curing in **lithium batteries**)
- IT **Crosslinking**  
(photochem.; synthesis and characterization of polyether urethane acrylate-LiCF<sub>3</sub>SO<sub>3</sub>-based **polymer electrolytes** by UV-curing in **lithium batteries**)
- IT **Polyurethanes, uses**  
RL: DEV (Device component use); PRP (Properties); **SPN (Synthetic preparation)**; **PREP (Preparation)**; **USES (Uses)**  
(polyether-; synthesis and characterization of polyether urethane acrylate-LiCF<sub>3</sub>SO<sub>3</sub>-based **polymer electrolytes** by UV-curing in **lithium batteries**)
- IT **Battery electrolytes**  
Ionic conductivity  
**Polymer electrolytes**  
(synthesis and characterization of polyether urethane acrylate-LiCF<sub>3</sub>SO<sub>3</sub>-based **polymer electrolytes** by UV-curing in **lithium batteries**)
- IT **Oligomers**  
RL: DEV (Device component use); PRP (Properties); **SPN (Synthetic preparation)**; **PREP (Preparation)**; **USES (Uses)**  
(synthesis and characterization of polyether urethane acrylate-LiCF<sub>3</sub>SO<sub>3</sub>-based **polymer electrolytes** by UV-curing in **lithium batteries**)
- IT 947-19-3, Irgacure 184  
RL: TEM (Technical or engineered material use); **USES (Uses)**  
(photoinitiator; synthesis and characterization of polyether urethane acrylate-LiCF<sub>3</sub>SO<sub>3</sub>-based **polymer electrolytes** by UV-curing in **lithium batteries**)
- IT 108-32-7, Propylene carbonate  
RL: TEM (Technical or engineered material use); **USES (Uses)**  
(plasticizer; synthesis and characterization of polyether urethane acrylate-LiCF<sub>3</sub>SO<sub>3</sub>-based **polymer electrolytes** by UV-curing in **lithium batteries**)
- IT 77-58-7, Dibutyltin dilaurate  
RL: CAT (Catalyst use); **USES (Uses)**  
(synthesis and characterization of polyether urethane acrylate-LiCF<sub>3</sub>SO<sub>3</sub>-based **polymer electrolytes** by UV-curing in **lithium batteries**)
- IT **33454-82-9DP, Lithium triflate, prepolymer complexes**  
**256473-40-2DP, lithium triflate-doped 256473-40-2P, Polyethylene glycol-hexamethylene diisocyanate**  
-caprolactone-modified hydroxyethyl acrylate copolymer 256473-41-3P  
**256473-42-4DP, lithium triflate-doped 256473-43-5P**  
**256473-44-6DP, lithium triflate-doped**  
RL: DEV (Device component use); PRP (Properties); **SPN (Synthetic**



**preparation); PREP (Preparation); USES (Uses)**  
 (synthesis and characterization of polyether **urethane**  
 acrylate-LiCF<sub>3</sub>SO<sub>3</sub>-based **polymer electrolytes** by  
 UV-curing in **lithium batteries**)

IT 7439-93-2, **Lithium**, properties

RL: PRP (Properties)

(transference no.; synthesis and characterization of polyether  
**urethane** acrylate-LiCF<sub>3</sub>SO<sub>3</sub>-based **polymer**  
**electrolytes** by UV-curing in **lithium**  
**batteries**)

RE.CNT 19 THERE ARE 19 CITED REFERENCES AVAILABLE FOR THIS RECORD

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IT 33454-82-9DP, **Lithium** triflate, prepolymer complexes

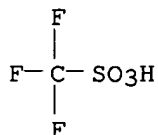
RL: DEV (Device component use); PRP (Properties); SPN (Synthetic

**preparation); PREP (Preparation); USES (Uses)**

(synthesis and characterization of polyether **urethane**  
 acrylate-LiCF<sub>3</sub>SO<sub>3</sub>-based **polymer electrolytes** by  
 UV-curing in **lithium batteries**)

RN 33454-82-9 HCAPLUS

CN Methanesulfonic acid, trifluoro-, lithium salt (8CI, 9CI) (CA INDEX NAME)



⊙ Li

IT 7439-93-2, **Lithium**, properties

RL: PRP (Properties)

(transference no.; synthesis and characterization of polyether  
**urethane** acrylate-LiCF<sub>3</sub>SO<sub>3</sub>-based **polymer**  
**electrolytes** by UV-curing in **lithium**

**batteries)**

RN 7439-93-2 HCAPLUS  
 CN Lithium (7CI, 8CI, 9CI) (CA INDEX NAME)

Li

L21 ANSWER 16 OF 44 HCAPLUS COPYRIGHT 2003 ACS

AN 1999:663411 HCAPLUS

DN 131:260005

TI Solid electrolyte **batteries** and their manufacture

IN Kato, Ikuo; Kahata, Toshiyuki; Taniuchi, Masahiro; Fujii, Toshishige

PA Ricoh Co., Ltd., Japan

SO Jpn. Kokai Tokkyo Koho, 13 pp.

CODEN: JKXXAF

DT Patent

LA Japanese

IC ICM H01M010-40

ICS H01M004-04; H01M004-62; H01M006-18; H01M006-22

CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)

FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	JP 11288738	A2	19991019	JP 1998-105514	19980401
PRAI	JP 1998-105514		19980401		

AB The **batteries** have a cathode contg. a **crosslinked** solid electrolyte at least on the surface of its active mass layer, an anode contg. a **crosslinked** solid electrolyte at least on the surface of its active mass layer facing the electrolyte layer on the cathode surface, and a **crosslinked** binder solid electrolyte layer between the electrodes. The **batteries** are prep'd. by forming the solid **electrolyte** layers on a cathode and an anode, applying a soln. of a **polymer** or a **polymerizable** comp'd. on the **electrolyte** layer on the cathode and/or anode, stacking the electrodes with the **electrolyte** layers facing each other, and gelling the soln. to form the binder **electrolyte**.

ST solid electrolyte **battery** structure manufIT **Polyurethanes**, uses

RL: DEV (Device component use); PEP (Physical, engineering or chemical process); PROC (Process); USES (Uses)

(electrolyte compns. for coating electrodes in solid electrolyte

**lithium batteries** contg. binder electrolyte layer)IT Secondary **batteries**(lithium; manuf. of **lithium batteries**

contg. binder electrolyte layer between solid electrolyte coated electrodes)

IT 9011-14-7, Polymethyl methacrylate 9011-17-0, Hexafluoropropylene-vinylidene fluoride copolymer 25014-41-9, Polyacrylonitrile

RL: DEV (Device component use); PEP (Physical, engineering or chemical process); PROC (Process); USES (Uses)

(binder electrolyte compns. for secondary **lithium****batteries** contg. solid electrolyte coated electrodes)IT 9059-74-9D, Hexamethylene **diisocyanate-polyethylene****glycol** copolymer, **crosslinked** 26570-48-9D,**Polyoxyethylene** diacrylate, **crosslinked** 52271-32-6D,

Methyl methacrylate-trimethylolpropane triacrylate copolymer,

**crosslinked**

RL: DEV (Device component use); PEP (Physical, engineering or chemical process); PROC (Process); USES (Uses)

(electrolyte compns. for coating electrodes in solid electrolyte

**lithium batteries** contg. binder electrolyte layer)

IT 96-49-1, Ethylene carbonate 108-32-7, Propylene carbonate 616-38-6, Dimethyl carbonate **90076-65-6**

RL: DEV (Device component use); PEP (Physical, engineering or chemical process); PROC (Process); USES (Uses)

(electrolyte compns. for **lithium batteries** contg.

binder electrolyte layer between solid electrolyte coated electrodes)

IT **90076-65-6**

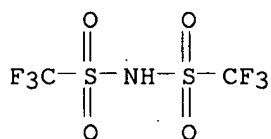
RL: DEV (Device component use); PEP (Physical, engineering or chemical process); PROC (Process); USES (Uses)

(electrolyte compns. for **lithium batteries** contg.

binder electrolyte layer between solid electrolyte coated electrodes)

RN 90076-65-6 HCAPLUS

CN Methanesulfonamide, 1,1,1-trifluoro-N-[(trifluoromethyl)sulfonyl]-, lithium salt (9CI) (CA INDEX NAME)



● Li

L21 ANSWER 17 OF 44 HCAPLUS COPYRIGHT 2003 ACS

AN 1998:682846 HCAPLUS

DN 129:316987

TI Composition effects in polyether **urethane**-based solid **polymer electrolytes**

AU Ng, Simon T. C.; Forsyth, Maria; MacFarland, Douglas R.; Garcia, Maria; Smith, Mark E.; Strange, John H.

CS Department of Materials Engineering, Monash Univ., Victoria, 3168, Australia

SO Polymer (1998), 39(25), 6261-6268

CODEN: POLMAG; ISSN: 0032-3861

PB Elsevier Science Ltd.

DT Journal

LA English

CC 37-5 (Plastics Manufacture and Processing)

Section cross-reference(s): 38, 72

AB NMR spectroscopy (n.m.r.), dynamic mech. thermal anal. (d.m.t.a.) and AC impedance techniques have been used in combination to probe the effect of **electrolyte** compn. in an archetypal solid **polymer electrolyte** compn. in an archetypal solid **polymer electrolyte** (SPE). A series of solid **polymer electrolytes** (SPEs) based on a **urethane-crosslinked** trifunctional poly(ethylene glycol) **polymer** host contg. dissolved ionic species (LiClO<sub>4</sub> and LiCF<sub>3</sub>SO<sub>3</sub>) have been studied. D.m.t.a. has established that increasing LiClO<sub>4</sub> concn. causes a

decrease in the polymer segmental mobility, owing to the formation of transient **crosslinks** via cation-polymer interaction. Investigation of the distribution of mech./structural relaxation times for the LiClO<sub>4</sub>/polymer complex with d.m.t.a. reveals that increasing LiClO<sub>4</sub> concn. causes a slight broadening of the distribution, indicating a more heterogeneous environment. Results of n.m.r. <sup>7</sup>Li T<sub>1</sub> and T<sub>2</sub> relaxation expts. support the idea that higher salt concns. encourage ionic aggregation. This is of crit. importance in detg. the cond. of the material since it affects the no. of charge carriers available. Introduction of the plasticizer tetraglyme into the LiClO<sub>4</sub>-based SPEs suppresses the glass transition temp. of the SPE, and causes a significant broadening of the relaxation time distribution (as measured by d.m.t.a.).

- ST **polyoxyalkylene polyurethane** solid electrolyte elec cond; viscoelasticity **polyoxyalkylene polyurethane lithium** complex electrolyte; tetraglyme plasticizer polyether **polyurethane** solid electrolyte; HMDI **crosslinked** oxirane methyloxirane copolymer electrolyte
- IT **Battery electrolytes**  
Glass transition  
Ionic conductivity  
Magnetic relaxation  
Viscoelasticity  
(compn. effects in polyether-**urethane**-based solid **polymer electrolytes**)
- IT **Polyurethanes**, properties  
RL: POF (Polymer in formulation); PRP (Properties); TEM (Technical or engineered material use); USES (Uses)  
(**polyoxyalkylene**-; compn. effects in polyether-**urethane**-based solid **polymer electrolytes**)
- IT Plasticizers  
(tetraglyme; compn. effects in polyether-**urethane**-based solid **polymer electrolytes**)
- IT **822-06-0D**, HMDI, **polymers** with trifunctional ethylene oxide-propylene oxide glycol, **Li** complexes **7439-93-2D**, **Lithium**, complexes with HMDI-**crosslinked** trifunctional ethylene oxide-propylene oxide glycol, properties 9003-11-6D, Ethylene oxide-propylene oxide copolymer, trifunctional glycol deriv., HMDI-**crosslinked**, **Li** complexes  
RL: POF (Polymer in formulation); PRP (Properties); TEM (Technical or engineered material use); USES (Uses)  
(compn. effects in polyether-**urethane**-based solid **polymer electrolytes**)
- IT **7791-03-9**, **Lithium** perchlorate **33454-82-9**, **Lithium** triflate  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(compn. effects in polyether-**urethane**-based solid **polymer electrolytes**)
- IT 143-24-8, Tetraglyme  
RL: MOA (Modifier or additive use); USES (Uses)  
(plasticizer; compn. effects in polyether-**urethane**-based solid **polymer electrolytes**)
- RE.CNT 44 THERE ARE 44 CITED REFERENCES AVAILABLE FOR THIS RECORD  
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  - (44) Wieczorek, W; J Phys Chem 1994, V98, P9047 HCAPLUS
- IT 822-06-0D, HMDI, **polymers** with trifunctional ethylene oxide-propylene oxide glycol, **Li** complexes 7439-93-2D, **Lithium**, complexes with HMDI-**crosslinked** trifunctional ethylene oxide-propylene oxide glycol, properties  
 RL: POF (Polymer in formulation); PRP (Properties); TEM (Technical or engineered material use); USES (Uses)  
 (compn. effects in polyether-**urethane**-based solid **polymer electrolytes**)
- RN 822-06-0 HCAPLUS
- CN Hexane, 1,6-diisocyanato- (9CI) (CA INDEX NAME)

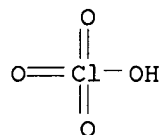
OCN- (CH<sub>2</sub>)<sub>6</sub>-NCO

RN 7439-93-2 HCAPLUS

CN Lithium (7CI, 8CI, 9CI) (CA INDEX NAME)

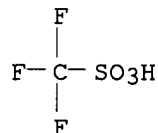
Li

IT 7791-03-9, Lithium perchlorate 33454-82-9,  
 Lithium triflate  
 RL: RCT (Reactant); RACT (Reactant or reagent)  
 (compn. effects in polyether-urethane-based solid  
 polymer electrolytes)  
 RN 7791-03-9 HCAPLUS  
 CN Perchloric acid, lithium salt (8CI, 9CI) (CA INDEX NAME)



Li

RN 33454-82-9 HCAPLUS  
 CN Methanesulfonic acid, trifluoro-, lithium salt (8CI, 9CI) (CA INDEX NAME)

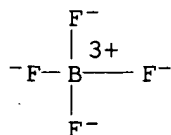


Li

L21 ANSWER 18 OF 44 HCAPLUS COPYRIGHT 2003 ACS  
 AN 1998:504885 HCAPLUS  
 DN 129:203401  
 TI Active ray-polymerizable compositions and their use in solid  
 electrolytes  
 IN Takeuchi, Masataka; Yabe, Masaji; Okubo, Takashi  
 PA Showa Denko K. K., Japan  
 SO Jpn. Kokai Tokkyo Koho, 16 pp.  
 CODEN: JKXXAF  
 DT Patent  
 LA Japanese  
 IC ICM C08F002-50  
 ICS C08F004-00; C08F020-22; C08F020-26; C08F020-58; C08F299-00;  
 C08G061-02; H01B001-12; H01G009-025; H01M010-40  
 CC 35-4 (Chemistry of Synthetic High Polymers)  
 Section cross-reference(s): 52  
 FAN.CNT 1

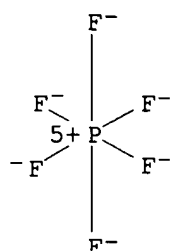
	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	JP 10204109	A2	19980804	JP 1997-8844	19970121
PRAI	JP 1996-313807		19961125		
OS	MARPAT 129:203401				
AB	The compns. with good film coatability and high ion cond. and capacity, esp. useful for primary and secondary <b>batteries</b> and capacitors, are obtained from (A) active ray- <b>polymerizable</b> compds. having functional groups which can form <b>crosslinked</b> or/and pendant-contg. <b>polymers</b> , (B) <b>electrolytes</b> and (C) <b>polymn.</b> initiators XCOY (X = optionally substituted aryl groups; Y = substituted phosphinoyl groups). Mixing a <b>triurethane</b> compd. derived from a propylene oxide adduct of glycerol and 2- <b>isocyanatoethyl</b> methacrylate, 1.0, with di-Et carbonate 1.5, ethylene carbonate 1.5, LiBF <sub>4</sub> 0.30 and Lucirin TPO (photoinitiator) 0.004 g, coating the resulting mixt. on a PET polyester film, and irradiating with chem. fluorescent light for 10 min gave a film contg. electrolyte.				
ST	<b>electrolyte</b> solid film forming <b>polymer</b> compn; ion cond solid <b>electrolyte</b> graft <b>polymer</b> ; photochem <b>polymn</b> methacrylate <b>polyoxyalkylene electrolyte</b> ; photoinitiator phosphine oxide <b>polymn polyoxyalkylene</b> methacrylate				
IT	Capacitors (double layer; manuf. of active ray- <b>polymerizable</b> compns. and use in solid <b>electrolytes</b> )				
IT	<b>Polyoxyalkylenes</b> , preparation RL: <b>IMF (Industrial manufacture)</b> ; PRP (Properties); TEM (Technical or engineered material use); <b>PREP (Preparation)</b> ; <b>USES (Uses)</b> (fluorine-contg., acrylic <b>urethane</b> adducts, <b>polymers</b> ; manuf. of active ray- <b>polymerizable</b> compns. and use in solid <b>electrolytes</b> )				
IT	Primary <b>batteries</b> Secondary <b>batteries</b> Solid <b>electrolytes</b> (manuf. of active ray- <b>polymerizable</b> compns. and use in solid <b>electrolytes</b> )				
IT	<b>Polyoxyalkylenes</b> , preparation RL: <b>IMF (Industrial manufacture)</b> ; PRP (Properties); TEM (Technical or engineered material use); <b>PREP (Preparation)</b> ; <b>USES (Uses)</b> (perfluoro, acrylic <b>urethane</b> adducts, <b>polymers</b> ; manuf. of active ray- <b>polymerizable</b> compns. and use in solid <b>electrolytes</b> )				
IT	<b>Polymerization</b> catalysts (photopolymn., phosphine oxide compds.; manuf. of active ray- <b>polymerizable</b> compns. and use in solid <b>electrolytes</b> )				
IT	Fluoropolymers, preparation Fluoropolymers, preparation RL: <b>IMF (Industrial manufacture)</b> ; PRP (Properties); TEM (Technical or engineered material use); <b>PREP (Preparation)</b> ; <b>USES (Uses)</b> ( <b>polyoxyalkylene-</b> , acrylic <b>urethane</b> adducts, <b>polymers</b> ; manuf. of active ray- <b>polymerizable</b> compns. and use in solid <b>electrolytes</b> )				
IT	14283-07-9 RL: TEM (Technical or engineered material use); <b>USES (Uses)</b> ( <b>electrolytes</b> ; manuf. of active ray- <b>polymerizable</b>				

- compns. and use in solid **electrolytes**)
- IT 145052-34-2, Bis(2,6-dimethoxybenzoyl)-2,4,4-trimethylpentyl phosphine oxide  
 RL: CAT (Catalyst use); USES (Uses)  
 (manuf. of active ray-**polymerizable** compns. and use in solid **electrolytes**)
- IT 202739-68-2P 202739-72-8P 212143-10-7P 212190-46-0DP, graft **polymer** with perfluoro polyoxymethylenepolyoxyethylene acrylic urethane deriv.  
 RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)  
 (manuf. of active ray-**polymerizable** compns. and use in solid **electrolytes**)
- IT 429-06-1, Tetraethylammonium tetrafluoroborate 21324-40-3, **Lithium** hexafluorophosphate (LiPF<sub>6</sub>)  
 RL: TEM (Technical or engineered material use); USES (Uses)  
 (manuf. of active ray-**polymerizable** compns. and use in solid **electrolytes**)
- IT 76287-91-7P 87260-75-1P  
 RL: IMF (Industrial manufacture); RCT (Reactant); PREP (Preparation); RACT (Reactant or reagent)  
 (monomer; reaction in manuf. of active ray-**polymerizable** compns. and use in solid **electrolytes**)
- IT 189146-15-4, Lucirin TPO  
 RL: CAT (Catalyst use); USES (Uses)  
 (photoinitiator; manuf. of active ray-**polymerizable** compns. and use in solid **electrolytes**)
- IT 375-01-9P, 2,2,3,3,4,4,4-Heptafluoro-1-butanol  
 RL: IMF (Industrial manufacture); RCT (Reactant); PREP (Preparation); RACT (Reactant or reagent)  
 (reaction in manuf. of active ray-**polymerizable** compns. and use in solid **electrolytes**)
- IT 25791-96-2, Propylene oxide **polymer** glyceryl ether 30674-80-7, 2-**Isocyanatoethyl** methacrylate 37286-64-9, **Polypropylene glycol** monomethyl ether 107852-51-7, Fomblin Z-DOL  
 RL: RCT (Reactant); RACT (Reactant or reagent)  
 (reaction in manuf. of active ray-**polymerizable** compns. and use in solid **electrolytes**)
- IT 14283-07-9  
 RL: TEM (Technical or engineered material use); USES (Uses)  
 (**electrolytes**; manuf. of active ray-**polymerizable** compns. and use in solid **electrolytes**)
- RN 14283-07-9 HCAPLUS
- CN Borate(1-), tetrafluoro-, lithium (8CI, 9CI) (CA INDEX NAME)





IT **21324-40-3, Lithium** hexafluorophosphate (LiPF<sub>6</sub>)  
 RL: TEM (Technical or engineered material use); USES (Uses)  
 (manuf. of active ray-**polymerizable** compns. and use in solid  
**electrolytes**)  
 RN 21324-40-3 HCAPLUS  
 CN Phosphate(1-), hexafluoro-, lithium (8CI, 9CI) (CA INDEX NAME)



Li<sup>+</sup>

L21 ANSWER 19 OF 44 HCAPLUS COPYRIGHT 2003 ACS  
 AN 1998:433676 HCAPLUS  
 DN 129:189826  
 TI **Polymer** solid **electrolytes** from poly(oxyethylene)  
 derivatives  
 AU Kohjiya, Shinzo; Ikeda, Yuko  
 CS Institute for Chemical Research, Kyoto University, Kyoto, 611-0011, Japan  
 SO Materials Science Research International (1998), 4(2), 73-78  
 CODEN: MSRIFY; ISSN: 1341-1683  
 PB Society of Materials Science, Japan  
 DT Journal; General Review  
 LA English  
 CC 36-0 (Physical Properties of Synthetic High Polymers)  
 AB A review with 13 refs. Mol. design of the **polymer** solid  
**electrolyte** based on rubbery state of **polymer** is  
 presented. Biocompatible segmented **polyurethane** elastomers with  
 poly(oxyethylene)-poly(oxytetramethylene)-poly(oxyethylene) segments were  
 used at first for the matrix of solid electrolyte. Next, oligomeric  
 poly(oxyethylene) (PEO) chains were grafted to polysiloxane main chain to  
 give a rubbery matrix for ion conduction when doped with LiClO<sub>4</sub>. The  
 latter showed higher conductivities than the former. However, the mech.  
 properties of the latter were poor, and its **crosslinking**  
 resulted in the lower cond. Copolymer prepd. from ethylene oxide and  
 epichlorohydrin was evaluated as a solid electrolyte. The epichlorohydrin  
 units did not contribute to the ion conduction resulting in relatively low  
 conductivities, though it was good in term of mech. properties. The final  
 mol. design of the ion conductive matrix was the high mol. wt. comb-shaped  
 PEO with oxyethylene segments as side chains. Both main and side chains  
 are oxyethylene units and the mol. wt. was in the order of 10<sup>6</sup>. The side  
 oxyethylene units discouraged crystn. of PEO. Excellent conductivities  
 were obsd. on doping with Li salts.  
 ST review solid electrolyte **polyoxyethylene** lithium salt  
 IT Ionic conductivity

**Polymer electrolytes**

(design and prepn. of **polymer** solid **electrolytes** from poly(oxyethylene) derivs. and **lithium** compds.)

- IT Simulation and Modeling, physicochemical  
(mol. design; design and prepn. of **polymer** solid **electrolytes** from poly(oxyethylene) derivs. and **lithium** compds.)
- IT **Urethane** rubber, processes  
RL: PEP (Physical, engineering or chemical process); **SPN (Synthetic preparation)**; **PREP (Preparation)**; PROC (Process)  
(**polyoxyalkylene**-, block, **lithium** complexes; design and prepn. of **polymer** solid **electrolytes** from poly(oxyethylene) derivs. and **lithium** compds.)
- IT **Silicone** rubber, processes  
**Silicone** rubber, processes  
RL: PEP (Physical, engineering or chemical process); **SPN (Synthetic preparation)**; **PREP (Preparation)**; PROC (Process)  
(**polyoxyalkylene**-, graft, **lithium** complexes; design and prepn. of **polymer** solid **electrolytes** from poly(oxyethylene) derivs. and **lithium** compds.)
- IT **Urethane** rubber, processes  
RL: PEP (Physical, engineering or chemical process); **SPN (Synthetic preparation)**; **PREP (Preparation)**; PROC (Process)  
(**polyoxyalkylene**-polyurea-, block, **lithium** complexes; design and prepn. of **polymer** solid **electrolytes** from poly(oxyethylene) derivs. and **lithium** compds.)
- IT **Synthetic** rubber, processes  
**Synthetic** rubber, processes  
RL: PEP (Physical, engineering or chemical process); **SPN (Synthetic preparation)**; **PREP (Preparation)**; PROC (Process)  
(**polyoxyalkylene**-siloxane, graft, **lithium** complexes; design and prepn. of **polymer** solid **electrolytes** from poly(oxyethylene) derivs. and **lithium** compds.)
- IT 115401-75-7DP, **lithium** complexes  
RL: PEP (Physical, engineering or chemical process); **SPN (Synthetic preparation)**; **PREP (Preparation)**; PROC (Process)  
(comb-shaped, rubber; design and prepn. of **polymer** solid **electrolytes** from poly(oxyethylene) derivs. and **lithium** compds.)
- IT 7439-93-2D, **Lithium**, **polyoxyethylene** side chain-contg. **polymer** complexes, processes  
RL: PEP (Physical, engineering or chemical process); PROC (Process)  
(design and prepn. of **polymer** solid **electrolytes** from poly(oxyethylene) derivs. and **lithium** compds.)
- IT 108006-87-7DP, 1,2-Ethylenediamine-MDI-**polyoxyethylene**-**polyoxytetramethylene** block copolymer, **lithium** complexes  
118722-26-2DP, Ethylene glycol-MDI-**polyoxyethylene**-**polyoxytetramethylene** block copolymer, **lithium** complexes  
211676-89-0DP, Dimethylsilanediol-methylsilanediol-**polyoxyethylene** acrylate methyl ether graft copolymer, **lithium** complexes  
211676-90-3DP, Methylsilanediol-**polyoxyethylene** diacrylate graft copolymer, **lithium** complexes  
RL: PEP (Physical, engineering or chemical process); PRP (Properties); **SPN (Synthetic preparation)**; **PREP (Preparation)**; PROC (Process)  
(rubber; design and prepn. of **polymer** solid

**electrolytes** from poly(oxyethylene) derivs. and **lithium** compds.)

IT 154429-82-ODP, **lithium** complexes

RL: PEP (Physical, engineering or chemical process); **SPN (Synthetic preparation); PREP (Preparation); PROC (Process)**

(rubber; design and prepn. of **polymer** solid

**electrolytes** from poly(oxyethylene) derivs. and **lithium** compds.)

RE.CNT 13 THERE ARE 13 CITED REFERENCES AVAILABLE FOR THIS RECORD  
RE

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- (2) Ikeda, Y; Polym Int 1997, V43, P269 HCAPLUS
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- (13) Wada, Y; Polym Prep Japan 1997, V46, P507

IT **7439-93-2D, Lithium, polyoxyethylene** side chain-contg. **polymer** complexes, processes

RL: PEP (Physical, engineering or chemical process); PROC (Process)  
(design and prepn. of **polymer** solid **electrolytes** from poly(oxyethylene) derivs. and **lithium** compds.)

RN 7439-93-2 HCAPLUS

CN Lithium (7CI, 8CI, 9CI) (CA INDEX NAME)

Li

L21 ANSWER 20 OF 44 HCAPLUS COPYRIGHT 2003 ACS

AN 1998:275021 HCAPLUS

DN 129:35350

TI Acrylic (fluoro)**polyoxyalkylene** solid electrolytes for compounding with electrodes useful in **batteries** and double-layer capacitors and manufacturing thereof

IN Takeuchi, Masataka; Yabe, Shoji; Okubo, Takashi; Tokita, Koji

PA Showa Denko K. K., Japan

SO Jpn. Kokai Tokkyo Koho, 18 pp.

CODEN: JKXXAF

DT Patent

LA Japanese

IC ICM H01B001-12

ICS C08G061-02; H01G009-025; H01M006-18; H01M010-40

CC 76-10 (Electric Phenomena)

Section cross-reference(s): 38, 52, 72

FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	JP 10116513	A2	19980506	JP 1996-270942	19961014
PRAI	JP 1996-270942		19961014		
AB	The solid <b>electrolyte</b> contains (A) <b>polyoxyalkylenes</b> or				

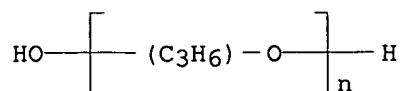
- oligooxyalkylenes, (B) .gtoreq.1 **polymer** having **crosslinked** or branched (oxy)fluorocarbon structures, (C) .gtoreq.1 **electrolyte**, and (D) .gtoreq.1 filler with av. particle size 0.01-100 .mu.m. The electrode using the above solid **electrolyte** is manufd. by (1) immersing a **polymerizable** compn. contg. (a) a thermally or active ray-**polymerizable** compd. pendent with **polymerizable** functional groups of CH<sub>2</sub>=CR<sub>1</sub>CO<sub>2</sub>R<sub>2</sub>- or CH<sub>2</sub>=CR<sub>3</sub>CO(OR<sub>4</sub>)<sub>x</sub>NHCO<sub>2</sub>R<sub>5</sub>- [R<sub>1</sub>, R<sub>3</sub> = H, alkyl; R<sub>2</sub>, R<sub>5</sub> = **polyoxyalkylene**-, oligooxyalkylene-, or (oxy)fluorocarbon-contg. group; R<sub>4</sub> = C.ltoreq.10 (heteroatom-contg.) divalent org. group; x = 0-10] , (b) .gtoreq.1 **electrolyte**, and (c) .gtoreq.1 filler with av. particle size 0.01-100 .mu.m in a electrode or placing it on a support and (2) **polymg.** it. The electrode obtained by the above method, **batteries** using the electrode, and an elec. double-layer capacitor using the above solid electrolyte are also claimed. The electrolyte shows high ion cond. and heat resistance and good mold processability.
- ST acrylic fluoro **polyoxyalkylene** solid electrolyte; methacrylic fluoro **polyoxyalkylene** solid electrolyte; **battery** electrode composite acrylic solid electrolyte; double layer capacitor solid electrolyte
- IT Secondary **batteries**  
Solid electrolytes  
(acrylic (fluoro)**polyoxyalkylene** solid electrolytes for compounding with electrodes useful in **batteries** and double-layer capacitors and manufg. thereof)
- IT Synthetic fibers  
RL: DEV (Device component use); TEM (Technical or engineered material use); USES (Uses)  
(aluminum oxide, Rubiel TRA 08, filler; acrylic (fluoro) **polyoxyalkylene** solid electrolytes for compounding with electrodes useful in **batteries** and double-layer capacitors and manufg. thereof)
- IT Capacitors  
(double layer; acrylic (fluoro)**polyoxyalkylene** solid electrolytes for compounding with electrodes useful in **batteries** and double-layer capacitors and manufg. thereof)
- IT **Polyoxyalkylenes**, uses  
**Polyoxyalkylenes**, uses  
RL: DEV (Device component use); IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)  
(fluorine-contg.; acrylic (fluoro)**polyoxyalkylene** solid electrolytes for compounding with electrodes useful in **batteries** and double-layer capacitors and manufg. thereof)
- IT **Polyoxyalkylenes**, uses  
RL: DEV (Device component use); IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)  
(methacrylate-terminated; acrylic (fluoro)**polyoxyalkylene** solid electrolytes for compounding with electrodes useful in **batteries** and double-layer capacitors and manufg. thereof)
- IT Fluoropolymers, uses  
Fluoropolymers, uses  
RL: DEV (Device component use); IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)  
(**polyoxyalkylene**-; acrylic (fluoro)**polyoxyalkylene** solid electrolytes for compounding with electrodes useful in

- batteries** and double-layer capacitors and manufg. thereof)
- IT **Polyoxyalkylenes**, uses  
 RL: DEV (Device component use); **IMF (Industrial manufacture)**;  
 RCT (Reactant); TEM (Technical or engineered material use); **PREP**  
**(Preparation)**; RACT (Reactant or reagent); **USES (Uses)**  
 (triol derivs., reaction products with **isocyanatoethyl**  
 methacrylate, **polymers** with carbonates; acrylic (fluoro)  
**polyoxyalkylene** solid **electrolytes** for compounding  
 with electrodes useful in **batteries** and double-layer  
 capacitors and manufg. thereof)
- IT 96-49-1DP, Ethylene carbonate, **polymers** with polypropylene  
 triols and **isocyanatoethyl** methacrylate 105-58-8DP, Diethyl  
 carbonate, **polymers** with polypropylene triols and  
**isocyanatoethyl** methacrylate **25322-69-4DP**, triol  
 derivs., reaction products with **isocyanatoethyl** methacrylate,  
**polymers** with carbonates 30674-80-7DP, 2-**Isocyanatoethyl**  
 methacrylate, reaction products with polypropylene triols,  
**polymers** with carbonates  
 RL: DEV (Device component use); **IMF (Industrial manufacture)**;  
 RCT (Reactant); TEM (Technical or engineered material use); **PREP**  
**(Preparation)**; RACT (Reactant or reagent); **USES (Uses)**  
 (acrylic (fluoro)**polyoxyalkylene** solid **electrolytes**  
 for compounding with electrodes useful in **batteries** and  
 double-layer capacitors and manufg. thereof)
- IT 32171-39-4DP, **polymers** with polypropylene triol,  
**isocyanatoethyl** methacrylate, and carbonates 107852-51-7DP,  
 Fomblin Z-DOL, reaction products with polyfluorocarbons and carbonates  
 203391-79-1DP, reaction products with polyoxyfluoroalkylenes,  
**isocyanatoethyl** methacrylate, and carbonates  
 RL: DEV (Device component use); **IMF (Industrial manufacture)**;  
 TEM (Technical or engineered material use); **PREP (Preparation)**;  
**USES (Uses)**  
 (acrylic (fluoro)**polyoxyalkylene** solid **electrolytes**  
 for compounding with electrodes useful in **batteries** and  
 double-layer capacitors and manufg. thereof)
- IT 375-01-9, 2,2,3,3,4,4,4-Heptafluoro-1-butanol  
 RL: RCT (Reactant); RACT (Reactant or reagent)  
 (acrylic (fluoro)**polyoxyalkylene** solid electrolytes for  
 compounding with electrodes useful in **batteries** and  
 double-layer capacitors and manufg. thereof)
- IT 429-06-1, Tetraethylammonium tetrafluoroborate **14283-07-9**,  
**Lithium** tetrafluoroborate **21324-40-3**, **Lithium**  
 hexafluorophosphate  
 RL: DEV (Device component use); TEM (Technical or engineered material  
 use); **USES (Uses)**  
 (electrolyte; acrylic (fluoro)**polyoxyalkylene** solid  
 electrolytes for compounding with electrodes useful in  
**batteries** and double-layer capacitors and manufg. thereof)
- IT 1344-28-1, Alumina, uses 7631-86-9, Aerosil RX 200, uses  
 RL: DEV (Device component use); TEM (Technical or engineered material  
 use); **USES (Uses)**  
 (filler; acrylic (fluoro)**polyoxyalkylene** solid electrolytes  
 for compounding with electrodes useful in **batteries** and  
 double-layer capacitors and manufg. thereof)
- IT **25322-69-4DP**, triol derivs., reaction products with  
**isocyanatoethyl** methacrylate, **polymers** with carbonates  
 RL: DEV (Device component use); **IMF (Industrial manufacture)**;  
 RCT (Reactant); TEM (Technical or engineered material use); **PREP**

(Preparation); RACT (Reactant or reagent); USES (Uses)  
 (acrylic (fluoro)**polyoxyalkylene** solid **electrolytes**  
 for compounding with electrodes useful in **batteries** and  
 double-layer capacitors and manufg. thereof)

RN 25322-69-4 HCAPLUS

CN Poly[oxy(methyl-1,2-ethanediyl)], .alpha.-hydro-.omega.-hydroxy- (9CI)  
 (CA INDEX NAME)



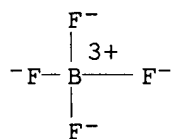
IT 14283-07-9, **Lithium** tetrafluoroborate 21324-40-3  
 , **Lithium** hexafluorophosphate

RL: DEV (Device component use); TEM (Technical or engineered material  
 use); USES (Uses)

(electrolyte; acrylic (fluoro)**polyoxyalkylene** solid  
 electrolytes for compounding with electrodes useful in  
**batteries** and double-layer capacitors and manufg. thereof)

RN 14283-07-9 HCAPLUS

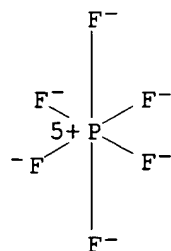
CN Borate(1-), tetrafluoro-, lithium (8CI, 9CI) (CA INDEX NAME)



$\text{Li}^+$

RN 21324-40-3 HCAPLUS

CN Phosphate(1-), hexafluoro-, lithium (8CI, 9CI) (CA INDEX NAME)



$\text{Li}^+$

L21 ANSWER 21 OF 44 HCAPLUS COPYRIGHT 2003 ACS  
 AN 1998:72101 HCAPLUS

KATHLEEN FULLER EIC 1700/PARKER LAW 308-4290

- DN 128:115626
- TI Synthesis and electrochemical characterization of **crosslinked** poly(ethylene oxide) containing  $\text{LiN}(\text{CF}_3\text{SO}_2)_2$
- AU Carvalho, L. M.; Guegan, P.; Cheradame, H.; Gomes, A. S.
- CS Inst. Macromoleculas Univ. Federal Rio de Janeiro, Rio de Janeiro, 21945-970, Brazil
- SO European Polymer Journal (1997), 33(10-12), 1741-1745  
CODEN: EUPJAG; ISSN: 0014-3057
- PB Elsevier Science Ltd.
- DT Journal
- LA English
- CC 37-5 (Plastics Manufacture and Processing)
- AB The ionic cond. of **polymeric electrolyte** systems comprising a network of poly(ethylene oxide) (PEO) **crosslinked** with 4,4',4''-methylidyne-tris(Ph **isocyanate**) [Desmodur RE] and contg.  $\text{LiN}(\text{CF}_3\text{SO}_2)_2$  (TFSILi), was studied. **Polyurethanes** based on three different PEO mol. wts. were prepd. Diffusion of TFSILi in swollen PEO-**urethane** membranes was studied using acetonitrile; the diffusion coeff. for PEO2000 was higher than that obsd. with  $\text{LiClO}_4$  in the same material. The Tg of the dried membranes was detd. as a function of salt concn. and **crosslink** d. The effect of salts Tg (for the TFSILi charged membranes) is equiv. to 25% of the effect of a covalent **crosslink**, in the range of mol. wt. between **crosslinks**. The relatively high slope of the plot of Tg-1 vs. salt concn. for PEO600 suggests a high level of chain rigidity due to the salt. The cond. of the network based on PEO2000 with a molar concn. ratio O/Li = 43 is 10-5 S/cm.
- ST **polyurethane** PEO **diisocyanate** lithium triflimide cond; ionic cond PEO **polyurethane** electrolyte
- IT **Polyurethanes**, preparation  
RL: PRP (Properties); SPN (**Synthetic preparation**); PREP (**Preparation**)  
(**polyoxyalkylene**-; prepn. and ionic cond. of electrolyte of PEO-**polyurethane-lithium** triflimide as function of **crosslink** d. and salt concn.)
- IT **Crosslink** density  
Diffusion  
Electrolytes  
Glass transition temperature  
Ionic conductivity  
**Polymer** networks  
(prepn. and ionic cond. of **electrolyte** of PEO-**polyurethane-lithium** triflimide as function of **crosslink** d. and salt concn.)
- IT **Polymer** chains  
(rigid; prepn. and ionic cond. of **electrolyte** of PEO-**polyurethane-lithium** triflimide as function of **crosslink** d. and salt concn.)
- IT 90076-65-6, **Lithium** triflimide  
RL: PEP (Physical, engineering or chemical process); PRP (Properties); PROC (Process)  
(prepn. and ionic cond. of electrolyte of PEO-**polyurethane-lithium** triflimide as function of **crosslink** d. and salt concn.)
- IT 75587-26-7P, **Polyethylene glycol**-triphenylmethane 4,4',4''-triisocyanate copolymer  
RL: PRP (Properties); SPN (**Synthetic preparation**); PREP (**Preparation**)

(prepn. and ionic cond. of electrolyte of PEO-**polyurethane-lithium** triflimide as function of **crosslink** d. and salt concn.)

IT 150604-75-4, Desmodur RE

RL: RCT (Reactant); RACT (Reactant or reagent)

(prepn. and ionic cond. of electrolyte of PEO-**polyurethane-lithium** triflimide as function of **crosslink** d. and salt concn.)

RE.CNT 16 THERE ARE 16 CITED REFERENCES AVAILABLE FOR THIS RECORD  
RE

- (1) Armand, M; Fast Ion Transport in Solid 1979
- (2) Armand, M; Second International Symposium on Polymer Electrolytes, Siena 1990, P91 HCAPLUS
- (3) Bouridah, A; Solid State Ionics 1985, V15, P233 HCAPLUS
- (4) Carvalho, L; 3.degree. Congresso Brasil Quim 1995, V2, P1243
- (5) Cheradame, H; Mat Res Soc Symp Proc 1993, V293, P123 HCAPLUS
- (6) Cheradame, H; Polymer Electrolyte Reviews 1 1987, P103
- (7) Crank, J; The Mathematics of Diffusion 1985
- (8) Guegan, P; Polym Prepr 1995, V34, P209
- (9) Le Nest, J; Macromolecules 1988, V21, P1117 HCAPLUS
- (10) Lestel, L; Second International Symposium on Polymer Electrolytes 1990, P143 HCAPLUS
- (11) Minier, M; J Phys 1980, V45, P739
- (12) Niddam-Mercier, P; Ph D Dissertation Institute National Polytechnique de Grenoble 1988
- (13) Takeoka, S; Polym Adv Technol 1993, V4, P53 HCAPLUS
- (14) Vallee, A; Electrochim Acta 1982, V37(9), P1579
- (15) Wright, P; Br Polym J 1976, V7, P319
- (16) Xu, K; Polym Adv Technol 1992, V3, P133 HCAPLUS

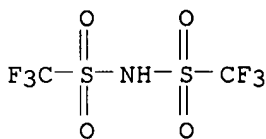
IT 90076-65-6, **Lithium** triflimide

RL: PEP (Physical, engineering or chemical process); PRP (Properties); PROC (Process)

(prepn. and ionic cond. of electrolyte of PEO-**polyurethane-lithium** triflimide as function of **crosslink** d. and salt concn.)

RN 90076-65-6 HCAPLUS

CN Methanesulfonamide, 1,1,1-trifluoro-N-[(trifluoromethyl)sulfonyl]-, lithium salt (9CI) (CA INDEX NAME)



● Li

L21 ANSWER 22 OF 44 HCAPLUS COPYRIGHT 2003 ACS

AN 1996:273818 HCAPLUS

DN 124:327255

TI Gelled electrolyte with good mechanical strength

IN Osada, Manabu; Akashi, Hiroyuki; Takemori, Shinichi; Sekai, Koji; Ozawa, Hitoshi; Nakajima, Kaoru; Karashima, Shuichi



PA Sumitomo Seika Kk, Japan; Sony Corp  
 SO Jpn. Kokai Tokkyo Koho, 8 pp.  
 CODEN: JKXXAF  
 DT Patent  
 LA Japanese  
 IC ICM H01B001-06  
 ICS C08G018-48; C08L075-08; H01M006-18  
 CC 72-3 (Electrochemistry)  
 Section cross-reference(s): 38, 52

FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	JP 08064028	A2	19960308	JP 1994-203249	19940829
PRAI	JP 1994-203249		19940829		

AB The **electrolyte** is obtained by treating a polyalkylene oxide with wt. av. mol. wt. 1000-1,000,000, a polyol, and an **isocyanate** compd. in the presence of an amine- and/or Sn-contg. catalyst, molding 100 parts of the resulting water-absorbing thermoplastic **polymer** and 0.1-20 parts of inorg. oxide, irradiating with 5-500-kGy electron beam, and impregnating with a soln. contg. an **electrolyte** and a nonaq. org. solvent. The electrolyte is useful for **Li batteries**, electrochem. devices, etc. The electrolyte showed high gel strength and good ionic cond.

ST polyalkylene **polyurethane** blend oxide electrolyte; electron beam **crosslinking** polyalkylene **polyurethane** electrolyte

IT Absorbents  
 (for water; gelled electrolyte contg. electron-beam-**crosslinked** polyalkylene-**polyurethane** and inorg. oxide with good gel strength)

IT **Battery** electrolytes  
**Crosslinking**  
 Electron beam  
 Gels  
 (gelled electrolyte contg. electron-beam-**crosslinked** polyalkylene-**polyurethane** and inorg. oxide with good gel strength)

IT Electrolytes  
 (manuf. of gelled electrolyte with good mech. strength)

IT **Urethane polymers**, uses  
 RL: TEM (Technical or engineered material use); USES (Uses)  
 (**polyoxyalkylene**-, gelled **electrolyte** contg. electron-beam-**crosslinked** polyalkylene-**polyurethane** and inorg. oxide with good gel strength)

IT 77-58-7, Dibutyltin dilaurate 102-71-6, Triethanolamine, uses 121-44-8, Triethylamine, uses 280-57-9, Triethylenediamine 301-10-0, Stannous octoate 1067-33-0  
 RL: CAT (Catalyst use); USES (Uses)  
 (catalysts; in manuf. of gelled electrolyte with good mech. strength)

IT 1309-48-4, Magnesium oxide, uses 1314-13-2, Finex 25, uses 1344-28-1, Aluminum oxide, uses **7791-03-9**, **Lithium** perchlorate 13463-67-7, MT 500B, uses **14283-07-9**, **Lithium** tetrafluoroborate **21324-40-3**, **Lithium** hexafluorophosphate 84135-65-9, Finesil T 32 112153-70-5, Aerosil R 805  
 RL: NUU (Other use, unclassified); USES (Uses)  
 (in manuf. of gelled electrolyte with good mech. strength)

IT 107040-16-4 107678-92-2 176676-78-1, Hexamethylene **diisocyanate**-1,9-nonanediol-**polyethylene oxide**

block copolymer 176676-79-2, 4,4'-Diphenylmethane **diisocyanate**  
 -ethylene glycol-**polyethylene oxide**-polypropylene  
 oxide block copolymer 176676-80-5

RL: TEM (Technical or engineered material use); USES (Uses)  
 (in manuf. of gelled electrolyte with good mech. strength)

IT 96-48-0, .gamma.-Butyrolactone 108-32-7, Propylene carbonate  
 RL: NUU (Other use, unclassified); USES (Uses)

(solvent; in manuf. of gelled electrolyte with good mech. strength)

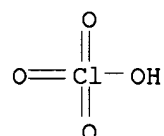
IT 7791-03-9, **Lithium** perchlorate 14283-07-9,  
**Lithium** tetrafluoroborate 21324-40-3, **Lithium**  
 hexafluorophosphate

RL: NUU (Other use, unclassified); USES (Uses)

(in manuf. of gelled electrolyte with good mech. strength)

RN 7791-03-9 HCAPLUS

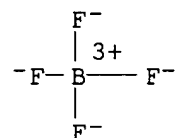
CN Perchloric acid, lithium salt (8CI, 9CI) (CA INDEX NAME)



Li

RN 14283-07-9 HCAPLUS

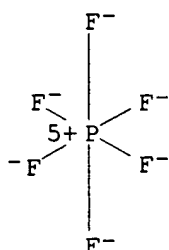
CN Borate(1-), tetrafluoro-, lithium (8CI, 9CI) (CA INDEX NAME)



Li<sup>+</sup>

RN 21324-40-3 HCAPLUS

CN Phosphate(1-), hexafluoro-, lithium (8CI, 9CI) (CA INDEX NAME)

Li<sup>+</sup>

L21 ANSWER 23 OF 44 HCAPLUS COPYRIGHT 2003 ACS  
 AN 1996:169144 HCAPLUS  
 DN 124:207235  
 TI Curable **polymer** precursors for solid **electrolytes** from  
 vinyl sulfonate-terminated **polyoxyalkylenes** linked by  
**urethane** with polyesters  
 IN Golovin, Milton N.  
 PA USA  
 SO U.S., 5 pp. Cont.-in-part of U.S. 5,262,253.  
 CODEN: USXXAM  
 DT Patent  
 LA English  
 IC ICM H01M010-40  
 NCL 429192000  
 CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
 Section cross-reference(s): 38  
 FAN.CNT 3

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	US 5489491	A	19960206	US 1994-230569	19940420
	US 5262253	A	19931116	US 1992-918438	19920722
	US 5498491	A	19960312	US 1994-193046	19940204
	WO 9529514	A1	19951102	WO 1995-US4459	19950410
	W: AM, AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LT, LU, LV, MD, MG, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TT RW: KE, MW, SD, SZ, UG, AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG				
	AU 9522854	A1	19951116	AU 1995-22854	19950410
PRAI	US 1992-918438	A2	19920722		
	US 1993-168881	B2	19931215		
	WO 1993-US6854	W	19930722		
	US 1994-230569	A	19940420		
	WO 1995-US4459	W	19950410		
AB	Vinyl sulfonate-derivatized oligomers of poly(oxyalkylene)glycols or polyesters and <b>isocyanate</b> are <b>urethane</b> -linked <b>polymer</b> precursors for the solid <b>polymeric</b> matrix of a solid <b>electrolyte</b> . The solid <b>electrolyte</b> <b>polymer</b> precursor can be represented by V <sub>k</sub> -Y-R <sub>2</sub> -k where k is 1 or				

2; R is H or C1-6 alkyl; V is CH<sub>2</sub>:CR<sub>5</sub>SO<sub>2</sub>-, Y is -O(ZnD)<sub>q</sub>Zn- where Zn is -(R<sub>2</sub>OC(O)R<sub>3</sub>C(O)O)<sub>n</sub>-; D is -C(O)NHR<sub>4</sub>NHC(O)O-; R<sub>1</sub> is H or C1-3 alkyl; R<sub>2</sub> is C1-12 hydrocarbylene or oxyhydrocarbylene; R<sub>3</sub> and R<sub>4</sub> are independently C1-12 hydrocarbylene groups; R<sub>5</sub> is H or C1-7 hydrocarbyl; n is 1-50; and q is 1-100. The solid polymeric matrix is made by **crosslinking** the vinyl sulfonate-derivatized oligomer.

ST **polymer** precursor solid **electrolyte**; polyester

**polyoxyalkylene urethane** linked electrolyte

IT **Battery electrolytes**

(curable **polymer** precursors for solid **battery electrolytes**)

IT **Polyoxyalkylenes**, uses

RL: TEM (Technical or engineered material use); USES (Uses)  
(polyester-, **urethane**-linked, vinyl sulfonate-terminated;  
curable **polymer** precursors for solid **battery electrolytes**)

IT Polyesters, uses

RL: TEM (Technical or engineered material use); USES (Uses)  
(**polyoxyalkylene**-, **urethane**-linked, vinyl  
sulfonate-terminated; curable **polymer** precursors for solid  
**battery electrolytes**)

IT 7440-44-0, Carbon, uses

RL: DEV (Device component use); USES (Uses)  
(anode, intercalatable; curable **polymer** precursors for solid  
**battery electrolytes**)

IT 1314-62-1, Vanadium oxide, uses 52627-24-4, Cobalt **lithium**  
oxide

RL: DEV (Device component use); USES (Uses)  
(cathode; curable **polymer** precursors for solid  
**battery electrolytes**)

L21 ANSWER 24 OF 44 HCAPLUS COPYRIGHT 2003 ACS

AN 1995:796362 HCAPLUS

DN 123:259069

TI An NMR investigation of ionic structure and mobility in plasticized solid  
**polymer electrolytes**

AU Forsyth, M.; MacFarlane, D. R.; Meakin, P.; Smith, M. E.; Bastow, T. J.

CS Dep. Materials Engineering, Monash Univ., Clayton, 3168, Australia

SO Electrochimica Acta (1995), 40(13-14), 2343-7

CODEN: ELCAAV; ISSN: 0013-4686

PB Elsevier

DT Journal

LA English

CC 38-3 (Plastics Fabrication and Uses)

AB 23Na and 19F NMR spectroscopy is used to investigate the effect of  
plasticizer addn. on ionic structure and mobility in a **urethane**  
**crosslinked** polyether solid **polymer electrolyte**

. The incorporation of DMF and propylene carbonate plasticizers in a  
sodium triflate/polyether system results in an upfield chem. shift for the  
23Na resonance consistent with decreased anion-cation assocn. and  
increased cation-plasticizer interactions. The 19F resonances appears  
less susceptible to changes in chem. environment with only minor chem.  
shift changes recorded. Spin lattice relaxation measurements for the 19F  
nucleus are also reported. Two min. are obsd. in the relaxation  
measurements consistent with both an inter and intramol. relaxation  
mechanism.

ST ionic structure plasticized solid **polymer electrolyte**;  
mobility plasticized solid **polymer electrolyte**;

- lithium complex urethane crosslinked polyoxyalkylene**  
**Battery electrolytes**  
 IT Chains, chemical  
 (NMR investigation of ionic structure and mobility in plasticized solid **polymer electrolytes**)  
 IT **Polyoxyalkylenes**, uses  
 RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)  
 (lithium complexes, **electrolytes** contg. trifluoromethanesulfonate; NMR investigation of ionic structure and mobility in plasticized solid **polymer electrolytes**)  
 IT Magnetic relaxation  
 (spin-lattice, NMR investigation of ionic structure and mobility in plasticized solid **polymer electrolytes**)  
 IT 68-12-2, Dimethyl formamide, uses 108-32-7, Propylene carbonate  
 RL: NUU (Other use, unclassified); USES (Uses)  
 (NMR investigation of ionic structure and mobility in plasticized solid **polymer electrolytes**)  
 IT 7439-93-2D, Lithium, Ethylene oxide-hexamethylene diisocyanate-propylene oxide copolymer complexes  
 RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)  
 (battery **electrolytes**; NMR investigation of ionic structure and mobility in plasticized solid **polymer electrolytes**)  
 IT 25766-15-8D, Ethylene oxide-hexamethylene diisocyanate-propylene oxide copolymer, **lithium** complexes  
 RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)  
 (electrolytes contg. trifluoromethanesulfonate; NMR investigation of ionic structure and mobility in plasticized solid **polymer electrolytes**)  
 IT 7439-93-2D, Lithium, Ethylene oxide-hexamethylene diisocyanate-propylene oxide copolymer complexes  
 RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)  
 (battery **electrolytes**; NMR investigation of ionic structure and mobility in plasticized solid **polymer electrolytes**)  
 RN 7439-93-2 HCAPLUS  
 CN Lithium (7CI, 8CI, 9CI) (CA INDEX NAME)

Li

- L21 ANSWER 25 OF 44 HCAPLUS COPYRIGHT 2003 ACS  
 AN 1995:796361 HCAPLUS  
 DN 123:259068  
 TI A 13C NMR study of the role of plasticizers in the conduction mechanism of solid **polymer electrolytes**  
 AU Forsyth, M.; Meakin, P. M.; MacFarlane, D. R.  
 CS Dep. Materials Engineering, Monash Univ., Clayton, 3168, Australia  
 SO Electrochimica Acta (1995), 40(13-14), 2339-42  
 CODEN: ELCAAV; ISSN: 0013-4686  
 PB Elsevier

DT Journal  
 LA English  
 CC 38-3 (Plastics Fabrication and Uses)  
 AB The addn. of low mol. wt. solvents such as DMF (DMF) and propylene carbonate (PC) to **urethane crosslinked** polyethers results in enhancement of polymer segmental motion, as detd. in this work from polymer 13C spin lattice relaxation measurements (T1) and glass transition temps. The formation of salt-polyether complexes results in a decrease in T1, even in the presence of the plasticizer, indicating that the polymer ether mols. are still involved in the alkali metal coordination. In a **polymer electrolyte** contg. 1 mol kg-1 LiClO4 the addn. of DMF and PC have significantly different affects on the **polymer** mobility, although they both enhance the cond. The cond. enhancement therefore is not solely the result of an increased solvent mobility.

ST plasticizer effect mechanism solid **polymer electrolyte**  
 ; **urethane crosslinked polyoxyalkylene**  
**battery** electrolyte

IT Chains, chemical  
 Glass temperature and transition  
 (13C NMR study of the role of plasticizers in the conduction mechanism of solid **polymer electrolytes**)

IT **Polyoxyalkylenes**, uses  
 RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)  
 (**lithium** complexes, **battery electrolytes**;  
 13C NMR study of the role of plasticizers in the conduction mechanism of solid **polymer electrolytes**)

IT Magnetic relaxation  
 (spin-lattice, 13C NMR study of the role of plasticizers in the conduction mechanism of solid **polymer electrolytes**)

IT 68-12-2, Dimethyl formamide, uses  
 RL: NUU (Other use, unclassified); USES (Uses)  
 (A 13C NMR study of the role of plasticizers in the conduction mechanism of solid **polymer electrolytes**)

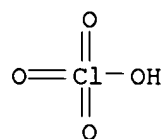
IT 25766-15-8D, Ethylene oxide-hexamethylene **diisocyanate**-propylene oxide copolymer, sodium or **lithium** complexes  
 RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)  
 (**battery electrolytes**; 13C NMR study of the role of plasticizers in the conduction mechanism of solid **polymer electrolytes**)

IT 7791-03-9, **Lithium** perchlorate  
 RL: NUU (Other use, unclassified); USES (Uses)  
 (**electrolytes** with ethylene oxide-hexamethylene **diisocyanate**-propylene oxide copolymer; 13C NMR study of the role of plasticizers in the conduction mechanism of solid **polymer electrolytes**)

IT 2926-30-9, Sodium trifluoromethanesulfonate  
 RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)  
 (**electrolytes** with ethylene oxide-hexamethylene **diisocyanate**-propylene oxide copolymer; 13C NMR study of the role of plasticizers in the conduction mechanism of solid **polymer electrolytes**)

IT 108-32-7, Propylene carbonate  
 RL: NUU (Other use, unclassified); USES (Uses)  
 (13C NMR study of the role of plasticizers in the conduction mechanism

of solid **polymer electrolytes**)  
 IT 7439-93-2D, **Lithium**, complexes with ethylene  
 oxide-hexamethylene **diisocyanate**-propylene oxide copolymer  
 7440-23-5D, Sodium, complexes with ethylene oxide-hexamethylene  
**diisocyanate**-propylene oxide copolymer  
 RL: PRP (Properties); TEM (Technical or engineered material use); USES  
 (Uses)  
 (13C NMR study of the role of plasticizers in the conduction mechanism  
 of solid **polymer electrolytes**)  
 IT 7791-03-9, **Lithium** perchlorate  
 RL: NUU (Other use, unclassified); USES (Uses)  
 (**electrolytes** with ethylene oxide-hexamethylene  
**diisocyanate**-propylene oxide copolymer; 13C NMR study of the  
 role of plasticizers in the conduction mechanism of solid  
**polymer electrolytes**)  
 RN 7791-03-9 HCAPLUS  
 CN Perchloric acid, lithium salt (8CI, 9CI) (CA INDEX NAME)



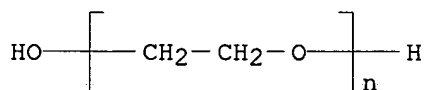
Li

IT 7439-93-2D, **Lithium**, complexes with ethylene  
 oxide-hexamethylene **diisocyanate**-propylene oxide copolymer  
 RL: PRP (Properties); TEM (Technical or engineered material use); USES  
 (Uses)  
 (13C NMR study of the role of plasticizers in the conduction mechanism  
 of solid **polymer electrolytes**)  
 RN 7439-93-2 HCAPLUS  
 CN Lithium (7CI, 8CI, 9CI) (CA INDEX NAME)

Li

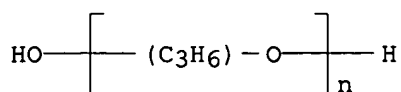
L21 ANSWER 26 OF 44 HCAPLUS COPYRIGHT 2003 ACS  
 AN 1995:796350 HCAPLUS  
 DN 123:318645  
 TI **Polymer electrolytes** based on modified  
 polysaccharides. 2. Polyether-modified cellulose  
 AU Schoenenberger, C.; Le Nest, J. F.; Gandini, A.  
 CS Materiaux Polymeres, INPG, St. Martin d'Heres, 38402, Fr.  
 SO Electrochimica Acta (1995), 40(13-14), 2281-4  
 CODEN: ELCAAV; ISSN: 0013-4686  
 PB Elsevier  
 DT Journal  
 LA English  
 CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
 Section cross-reference(s): 37

- AB In order to improve the film-forming properties of polyether-based **polymer electrolytes** a new family of materials was synthesized. The structures described in this work involve a cellulosic ether backbone on which oligoethers were grafted and **crosslinked** in various proportions via **urethane** chem. and to which **lithium** perchlorate was subsequently added as a source of ionic species. The resulting networks were fully characterized in terms of glass transition temp. dynamic mech. properties and ionic cond. With respect to the optimized polyether-based networks studied previously, the introduction of polysaccharide chains does not alter the basic features neither qual. nor quant.
- ST **battery electrolyte polymer** modified polysaccharide; polyether modified cellulosic **battery** electrolyte
- IT **Battery** electrolytes  
Glass temperature and transition  
(electrolytes based on reaction of cellulose ethers with polyether-based **isocyanates**)
- IT Electric conductivity and conduction  
(ionic, electrolytes based on reaction of cellulose ethers with polyether-based **isocyanates**)
- IT 9004-62-0D, Hydroxyethylcellulose, **polymers** with polypropylene oxide **isocyanates** and PEO **diisocyanates**  
**25322-68-3D**, Polyethyleneoxide, **isocyanates**, **polymers** with hydroxyethylcellulose **25322-69-4D**, Polypropylene oxide, **isocyanates**, **polymers** with hydroxyethylcellulose  
RL: PRP (Properties)  
(**electrolytes** based on reaction of cellulose ethers with polyether-based **isocyanates**)
- IT **7791-03-9**, **Lithium** perchlorate  
RL: PRP (Properties)  
(electrolytes based on reaction of cellulose ethers with polyether-based **isocyanates** and)
- IT **25322-68-3D**, Polyethyleneoxide, **isocyanates**, **polymers** with hydroxyethylcellulose **25322-69-4D**, Polypropylene oxide, **isocyanates**, **polymers** with hydroxyethylcellulose  
RL: PRP (Properties)  
(**electrolytes** based on reaction of cellulose ethers with polyether-based **isocyanates**)
- RN 25322-68-3 HCAPLUS
- CN Poly(oxy-1,2-ethanediyl), .alpha.-hydro-.omega.-hydroxy- (9CI) (CA INDEX NAME)

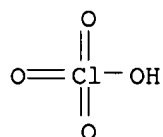


- RN 25322-69-4 HCAPLUS
- CN Poly[oxy(methyl-1,2-ethanediyl)], .alpha.-hydro-.omega.-hydroxy- (9CI)  
(CA INDEX NAME)





IT 7791-03-9, **Lithium** perchlorate  
 RL: PRP (Properties)  
 (electrolytes based on reaction of cellulose ethers with  
 polyether-based **isocyanates** and)  
 RN 7791-03-9 HCAPLUS  
 CN Perchloric acid, lithium salt (8CI, 9CI) (CA INDEX NAME)



Li

L21 ANSWER 27 OF 44 HCAPLUS COPYRIGHT 2003 ACS  
 AN 1995:637272 HCAPLUS  
 DN 123:57315  
 TI Conductivity studies of **polymer electrolytes** based on  
 aliphatic polyesters  
 AU Kim, Dong-Won; Park, Jung-Ki; Gong, Myoung-Seon  
 CS Dep. Chem. Eng., Korea Adv. Inst. Sci. Technol., Daejeon, 305-701, S. Korea  
 SO Journal of Polymer Science, Part B: Polymer Physics (1995), 33(9), 1323-31  
 CODEN: JPBPEM; ISSN: 0887-6266  
 PB Wiley  
 DT Journal  
 LA English  
 CC 37-3 (Plastics Manufacture and Processing)  
 Section cross-reference(s): 39, 76  
 AB A series of aliph. polyesters of sebacoyl chloride and poly(ethylene glycol) contg. a different no. of ethylene oxide groups was synthesized and characterized. These polyesters were complexed with **lithium** perchlorate to obtain a new class of **polymer electrolyte**. The relationships between the structure and properties of these **polymer electrolytes** were investigated. The main factor that affects the ionic cond. in these systems was the solvating capacity of the polyester for the **lithium** salt. These **polymer electrolytes** showed ionic conductivities up to  $10^{-5}$ - $10^{-4}$  S/cm at 25.degree.. The mech. strength was improved by **crosslinking**, and the **crosslinked** polyester complexed with a LiClO4 salt showed an ionic cond. of 2 .times.  $10^{-5}$  S/cm at room temp.  $^7\text{Li}$  NMR spin-spin relaxation and dielec. relaxation studies were also carried out to investigate the local environment and dynamics of ions in the **polymer electrolytes**.  
 ST aliph polyester **lithium** complex polyelectrolyte;  
 polyethylene glycol polyester **lithium** complex;  
 ionic cond polyester **polyoxyalkylene** complex

- IT Rubber, **urethane**, preparation  
 RL: PRP (Properties); **SPN (Synthetic preparation); PREP (Preparation)**  
 (hexamethylene **diisocyanate-polyethylene glycol-polyoxypropylene** triol-sebacoyl chloride, **lithium** complexes; ionic cond. of aliph. polyester-**polyoxyalkylene-based polymer electrolytes**)
- IT Crystallinity  
**Electrolytes**  
 Glass temperature and transition  
 Heat of fusion and Heat of freezing  
 (ionic cond. and thermal properties of aliph. polyester-**polyoxyalkylene-based polymer electrolytes**)
- IT Electric conductivity and conduction  
 (ionic, ionic cond. and thermal properties of aliph. polyester-**polyoxyalkylene-based polymer electrolytes**)
- IT **Polyoxyalkylenes**, preparation  
 RL: PRP (Properties); **SPN (Synthetic preparation); PREP (Preparation)**  
 (polyester-, ionic cond. of aliph. polyester-**polyoxyalkylene-based polymer electrolytes**)
- IT **Polyoxyalkylenes**, preparation  
 RL: PRP (Properties); **SPN (Synthetic preparation); PREP (Preparation)**  
 (polyester-, metal complexes, ionic cond. of aliph. polyester-**polyoxyalkylene-based polymer electrolytes**)
- IT Polyesters, preparation  
 RL: PRP (Properties); **SPN (Synthetic preparation); PREP (Preparation)**  
 (polyoxyalkylene-, ionic cond. of aliph. polyester-**polyoxyalkylene-based polymer electrolytes**)
- IT Polyesters, preparation  
 RL: PRP (Properties); **SPN (Synthetic preparation); PREP (Preparation)**  
 (polyoxyalkylene-, metal complexes, ionic cond. of aliph. polyester-**polyoxyalkylene-based polymer electrolytes**)
- IT **7791-03-9DP**, complexes with polyester-**polyoxyalkylenes**  
**28650-91-1DP**, Triethylene glycol-sebacoyl chloride copolymer, sru, **lithium** complexes **28650-91-1P**, Triethylene glycol-sebacoyl chloride copolymer, sru **164854-23-3DP**, Triethylene glycol-sebacoyl chloride copolymer, **lithium** complexes **164854-23-3P**, Triethylene glycol-sebacoyl chloride copolymer **164854-24-4DP**, Tetraethylene glycol-sebacoyl chloride copolymer, **lithium** complexes **164854-24-4P**, Tetraethylene glycol-sebacoyl chloride copolymer, sru, **164854-25-5DP**, Tetraethylene glycol-sebacoyl chloride copolymer, sru, **lithium** complexes **164854-25-5P**, Tetraethylene glycol-sebacoyl chloride copolymer, sru **164854-26-6DP**, Hexaethylene glycol-sebacoyl chloride copolymer, **lithium** complexes **164854-26-6P**, Hexaethylene glycol-sebacoyl chloride copolymer **164854-27-7DP**, Hexaethylene glycol-sebacoyl chloride copolymer, sru, **lithium** complexes **164854-27-7P**, Hexaethylene glycol-sebacoyl chloride copolymer, sru **164854-28-8DP**, Nonaethylene glycol-sebacoyl chloride copolymer, **lithium** complexes **164854-28-8P**, Nonaethylene glycol-sebacoyl chloride copolymer **164854-29-9DP**, Nonaethylene glycol-sebacoyl chloride copolymer, sru, **lithium** complexes **164854-29-9P**, Nonaethylene glycol-sebacoyl chloride copolymer, sru **164854-30-2DP**, **Polyethylene glycol-sebacoyl chloride copolymer**,

**lithium complexes 164854-30-2P, Polyethylene glycol-sebacoyl chloride copolymer**  
 RL: PRP (Properties); SPN (Synthetic preparation); PREP  
 (Preparation)

(ionic cond. of aliph. polyester-polyoxyalkylene-based  
**polymer electrolytes**)

IT 111-19-3DP, Sebacoyl chloride, **polymer** with hexamethylene  
**diisocyanate**, poly(ethylene glycol) and poly(propylene oxide)  
 triol deriv., **lithium complexes 822-06-ODP**,  
 Hexamethylene **diisocyanate**, **polymer** with poly(ethylene  
 glycol), poly(propylene oxide) triol deriv. and sebacoyl chloride,  
**lithium complexes 25322-68-3DP**, **polymer** with  
 hexamethylene **diisocyanate**, poly(propylene oxide) triol deriv.  
 and sebacoyl chloride, **lithium complexes 25322-69-4DP**,  
 triol derivs., **polymer** with hexamethylene **diisocyanate**  
 , poly(ethylene glycol) and sebacoyl chloride, **lithium complexes**  
 RL: PRP (Properties); SPN (Synthetic preparation); PREP  
 (Preparation)

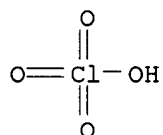
(rubber; ionic cond. of aliph. polyester-polyoxyalkylene  
 -based **polymer electrolytes**)

IT 7791-03-9DP, complexes with polyester-polyoxyalkylenes  
 RL: PRP (Properties); SPN (Synthetic preparation); PREP  
 (Preparation)

(ionic cond. of aliph. polyester-polyoxyalkylene-based  
**polymer electrolytes**)

RN 7791-03-9 HCAPLUS

CN Perchloric acid, lithium salt (8CI, 9CI) (CA INDEX NAME)



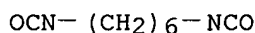
● Li

IT 822-06-ODP, Hexamethylene **diisocyanate**, **polymer**  
 with poly(ethylene glycol), poly(propylene oxide) triol deriv. and  
 sebacoyl chloride, **lithium complexes 25322-68-3DP**,  
**polymer** with hexamethylene **diisocyanate**, poly(propylene  
 oxide) triol deriv. and sebacoyl chloride, **lithium complexes**  
**25322-69-4DP**, triol derivs., **polymer** with hexamethylene  
**diisocyanate**, poly(ethylene glycol) and sebacoyl chloride,  
**lithium complexes**  
 RL: PRP (Properties); SPN (Synthetic preparation); PREP  
 (Preparation)

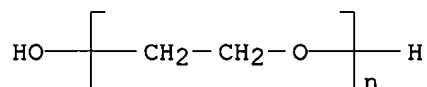
(rubber; ionic cond. of aliph. polyester-polyoxyalkylene  
 -based **polymer electrolytes**)

RN 822-06-0 HCAPLUS

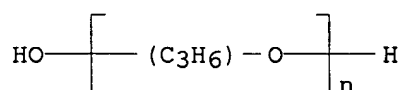
CN Hexane, 1,6-diisocyanato- (9CI) (CA INDEX NAME)



RN 25322-68-3 HCAPLUS  
 CN Poly(oxy-1,2-ethanediyl), .alpha.-hydro-.omega.-hydroxy- (9CI) (CA INDEX NAME)



RN 25322-69-4 HCAPLUS  
 CN Poly[oxy(methyl-1,2-ethanediyl)], .alpha.-hydro-.omega.-hydroxy- (9CI) (CA INDEX NAME)



L21 ANSWER 28 OF 44 HCAPLUS COPYRIGHT 2003 ACS  
 AN 1994:413912 HCAPLUS  
 DN 121:13912  
 TI Gel electrolytes for **lithium batteries** sand electrochemical devices  
 IN Yamamoto, Takushi; Sekai, Kohji; Nakamura, Morio; Nishi, Yoshio; Tanaka, Hitoshi; Ozawa, Hitoshi; Maeda, Nobuhivo  
 PA Sumitomo Seika Chemicals Co., Ltd., Japan; Sony Corp.  
 SO PCT Int. Appl., 23 pp.  
 CODEN: PIXXD2  
 DT Patent  
 LA Japanese  
 IC ICM H01M006-18  
 ICS H01M006-22; H01M010-40  
 CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
 Section cross-reference(s): 37, 38  
 FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	WO 9406165	A1	19940317	WO 1993-JP1272	19930908
	W: US				
	RW: AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE				
	JP 06140052	A2	19940520	JP 1993-206306	19930820
PRAI	JP 1992-239418		19920908		
	JP 1993-206306		19930820		
AB	The gel electrolytes comprise a matrix contg. 0.2-20 wt. parts inorg. oxides and 100 wt. parts poly(alkylene oxide) having wt. av. mol. wt. 1000-1,000,000 <b>crosslinked</b> by <b>isocyanates</b> and a nonaq. soln of an inorg. electrolyte impregnated in the matrix. The electrolytes have high cond. and mech. strength.				
ST	<b>lithium battery</b> gelled electrolyte; polyalkylene oxide electrolyte <b>lithium battery</b> ; inorg oxide additive <b>battery</b> gelled electrolyte				
IT	<b>Battery electrolytes</b> (gelled, <b>polymer</b> matrixes contg. inorg oxides for)				
IT	<b>Urethane polymers</b> , uses				

RL: USES (Uses)  
 (**polyoxyalkylene-**, matrixes contg. inorg. oxides and, gelled  
**electrolytes** contg., for **lithium batteries**)

IT 7791-03-9, Lithium perchlorate 14283-07-9,  
 Lithium fluoroborate  
 RL: USES (Uses)  
 (**electrolyte, polymer** matrixes contg. inorg. oxides  
 for gelled, in **lithium batteries**)

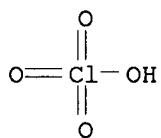
IT 9042-77-7 9059-74-9 25766-14-7 37278-61-8 60941-30-2  
 RL: USES (Uses)  
 (matrixes contg. inorg. oxides and, gelled electrolytes contg., for  
**lithium batteries**)

IT 1309-48-4, Magnesia, uses 1314-13-2, Zinc oxide, uses 1344-28-1,  
 Alumina, uses 7631-86-9, Silica, uses 13463-67-7, Titania, uses  
 RL: USES (Uses)  
 (**polymer** matrixes contg., gelled **electrolytes**  
 contg., for **lithium batteries**)

IT 96-48-0, .gamma.-Butyrolactone 108-32-7, Propylene carbonate  
 RL: USES (Uses)  
 (solvent, gelled **electrolytes** contg., **polymer**  
 matrixes contg. inorg. oxides for, in **lithium**  
**batteries**)

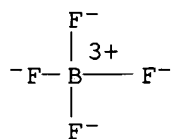
IT 7791-03-9, Lithium perchlorate 14283-07-9,  
 Lithium fluoroborate  
 RL: USES (Uses)  
 (**electrolyte, polymer** matrixes contg. inorg. oxides  
 for gelled, in **lithium batteries**)

RN 7791-03-9 HCAPLUS  
 CN Perchloric acid, lithium salt (8CI, 9CI) (CA INDEX NAME)



Li

RN 14283-07-9 HCAPLUS  
 CN Borate(1-), tetrafluoro-, lithium (8CI, 9CI) (CA INDEX NAME)

Li<sup>+</sup>

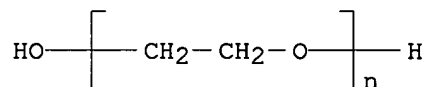
L21 ANSWER 29 OF 44 HCAPLUS COPYRIGHT 2003 ACS  
 AN 1994:137487 HCAPLUS  
 DN 120:137487  
 TI Macromolecular materials based on polysaccharides for ionic conductors  
 IN Gandini, Alessandro; Le Nest, Jean Francois  
 PA Institut National Polytechnique de Grenoble, Fr.  
 SO PCT Int. Appl., 21 pp.  
 CODEN: PIXXD2  
 DT Patent  
 LA French  
 IC ICM C08B015-00  
 ICS C08B031-00; C08B033-00; C08B037-08; C08B037-14; H01M006-18;  
 H01M010-40

CC 43-3 (Cellulose, Lignin, Paper, and Other Wood Products)  
 Section cross-reference(s): 44, 52, 76

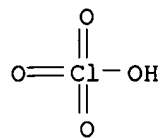
FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	WO 9316108	A1	19930819	WO 1993-FR140	19930211
	W: CA, JP, US				
	RW: AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE				
	FR 2687405	A1	19930820	FR 1992-1581	19920213
PRAI	FR 1992-1581		19920213		
AB	The title materials, with good mech. and film-forming properties and useful as solid electrolytes, comprise linear or branched oligo- or polysaccharides and/or their derivs. bearing solvating and anionic groups. Heating 3 g cellulose and 6 g <b>polyoxyethylene diisocyanate</b> (mol. wt. 600) with a Sn catalyst in DMSO at 60.degree. for 24 h gave a gel which was extd. with CH <sub>2</sub> Cl <sub>2</sub> , dried, and impregnated with 10% LiClO <sub>4</sub> to give a membrane with glass temp. -30.degree., elec. cond. 10-5 S/cm at 25.degree., and elastic modulus 107 Pa at 25.degree..				
ST	elec conductor ionic polysaccharide; <b>polyurethane</b> cellulose solid electrolyte; <b>polyoxyalkylene polyurethane</b> cellulose <b>crosslinking</b> polyelectrolyte; electrolyte solid cellulose <b>polyurethane</b> ; <b>lithium</b> perchlorate polysaccharide electrolyte				
IT	<b>Battery</b> electrolytes (polysaccharide-based, solid)				
IT	Phosphazene <b>polymers</b> Polyamines Polysulfides Siloxanes and Silicones, uses RL: USES (Uses) (polysaccharide-contg., <b>lithium</b> salt-impregnated, as solid <b>electrolytes</b> )				
IT	Oligosaccharides RL: USES (Uses) (derivs., ionic, <b>lithium</b> salt-impregnated, as solid electrolytes)				
IT	Windows (electrochromic, polysaccharide-based solid electrolytes for use in)				
IT	Polysaccharides, uses RL: USES (Uses) (ionic, <b>lithium</b> salt-impregnated, as solid electrolytes)				
IT	<b>Polyoxyalkylenes</b> , uses RL: USES (Uses) (polyester-, cellulose-based, <b>lithium</b> salt-impregnated, as				

- solid electrolytes)
- IT Polyesters, uses  
**Urethane polymers**, uses  
 RL: USES (Uses)  
 (polyoxyalkylene-, cellulose-based, lithium salt-impregnated, as solid electrolytes)
- IT Electrolytes  
 (solid, ionic polysaccharides for use in)
- IT 1189-71-5D, Chlorosulfonyl **isocyanate**, reaction products with cellulose-based **polyurethanes** 1398-61-4D, Chitin, ionic derivs. 2370-88-9D, 2,4,6,8-Tetramethylcyclotetrasiloxane, reaction products with polyoxyethylated Me cellulose 9004-34-6D, Cellulose, reaction products with **polyoxyethylene diisocyanates** 9004-62-0D, 2-Hydroxyethyl cellulose, reaction products with **polyoxyethylene diisocyanates** 9004-67-5D, Methyl cellulose, ethers with **polyethylene glycol**, reaction products with tetramethylcyclotetrasiloxane 9005-25-8D, Starch, ionic derivs. 9005-82-7D, Amylose, reaction products with **polyoxyethylene diisocyanates** 9012-76-4D, Chitosan, ionic derivs. 9034-32-6D, Hemicellulose, ionic derivs. 25322-68-3D, **Polyethylene glycol**, **diisocyanate** derivs., reaction products with cellulose  
 RL: USES (Uses)  
 (lithium salt-impregnated, as solid electrolytes)
- IT 7791-03-9, **Lithium perchlorate** 33454-82-9, **Lithium** trifluoromethanesulfonate 90076-65-6, **Lithium** bis(trifluoromethanesulfonyl)imide  
 RL: USES (Uses)  
 (polysaccharides impregnated with, as solid electrolytes)
- IT 25322-68-3D, **Polyethylene glycol**, **diisocyanate** derivs., reaction products with cellulose  
 RL: USES (Uses)  
 (lithium salt-impregnated, as solid electrolytes)
- RN 25322-68-3 HCAPLUS
- CN Poly(oxy-1,2-ethanediyl), .alpha.-hydro-.omega.-hydroxy- (9CI) (CA INDEX NAME)

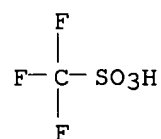


- IT 7791-03-9, **Lithium perchlorate** 33454-82-9, **Lithium** trifluoromethanesulfonate 90076-65-6, **Lithium** bis(trifluoromethanesulfonyl)imide  
 RL: USES (Uses)  
 (polysaccharides impregnated with, as solid electrolytes)
- RN 7791-03-9 HCAPLUS
- CN Perchloric acid, lithium salt (8CI, 9CI) (CA INDEX NAME)



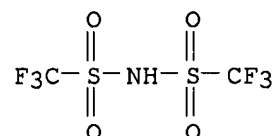
Li

RN 33454-82-9 HCAPLUS  
CN Methanesulfonic acid, trifluoro-, lithium salt (8CI, 9CI) (CA INDEX NAME)



Li

RN 90076-65-6 HCAPLUS  
CN Methanesulfonamide, 1,1,1-trifluoro-N-[(trifluoromethyl)sulfonyl]-, lithium salt (9CI) (CA INDEX NAME)



● Li

L21 ANSWER 30 OF 44 HCAPLUS COPYRIGHT 2003 ACS  
AN 1992:491879 HCAPLUS  
DN 117:91879  
TI Functionalized polyether-type ion-conducting **polymer electrolytes**  
IN Motogami, Kenji; Mori, Shigeo  
PA Daiichi Kogyo Seiyaku K. K., Japan  
SO Jpn. Kokai Tokkyo Koho, 12 pp.  
CODEN: JKXXAF  
DT Patent  
LA Japanese  
IC ICM C08L071-02  
ICS C08F299-02; C08G018-48; H01B001-06; H01M006-18; H01M010-40  
CC 38-3 (Plastics Fabrication and Uses)



Section cross-reference(s): 72

FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	JP 04068064	A2	19920303	JP 1990-180355	19900706
	JP 2923542	B2	19990726		
PRAI	JP 1990-180355		19900706		
AB	The title polyethers, being used with sol. <b>electrolyte</b> salts and O- and/or N-contg. org. solvents, have low glass-transition temp. (Tg), and are amorphous <b>polymers</b> obtained by the <b>crosslinking</b> of the active H-contg. compd.-initiated block or random addn. products of glycidyl ethers and C.gtoreq.3 alkylene oxides which bear terminal functional groups. The amorphous nature of the polymers can prevent the sudden decrease of cond. at low temp. as seen in cryst. similar polymers. Thus, the KOH-catalyzed reaction of glycerol initiator 15 with 1,2-epoxybutane 370, then with glycidyl triethylene glycol Me ether 285 g gave a polyether which was esterified with acrylic acid (I) at the OH/I equiv. wt. ratio 1.1:1. Heating 3.6 g the acrylate polyether-polyol with 0.12 g LiClO4 and a MEK soln. of photoinitiator under N at 80.degree. for 1 h and in vacuo for 8 h to remove MEK, and impregnating into 1.8 g propylene carbonate gave a title product which showed ion cond. $1.8 \times 10^{-4}$ , $1.0 \times 10^{-4}$ , and $5.2 \times 10^{-5}$ s/cm at 20, 0 and -20.degree., resp.				
ST	complex polyether polyol <b>crosslinked</b> electrolyte; <b>polyoxyalkylene</b> polyol acrylate <b>polymer electrolyte</b> ; lithium perchlorate <b>polyoxyalkylene</b> acrylate polymer				
IT	Electric conductors Polyelectrolytes (prepn. of, amorphous <b>polyoxyalkylene</b> -polyol-based acrylic polymers or <b>urethane</b> polymer complexes for)				
IT	Epoxides RL: <b>PREP (Preparation)</b> (C12, <b>polymers</b> , with glycidyl ethers, ether with sorbitol, methacrylate, <b>polymers</b> , metal complexes, <b>electrolytes</b> , prepn. of)				
IT	Epoxides RL: <b>PREP (Preparation)</b> (C4, <b>polymers</b> , with glycidyl ethers, ether with sorbitol, methacrylate, <b>polymers</b> , metal complexes, <b>electrolytes</b> , prepn. of)				
IT	Epoxides RL: <b>PREP (Preparation)</b> (C6, <b>polymers</b> , with glycidyl ethers, ether with sorbitol, methacrylate, <b>polymers</b> , metal complexes, <b>electrolytes</b> , prepn. of)				
IT	<b>Polyoxyalkylenes</b> , preparation RL: <b>PREP (Preparation)</b> (acrylic, polyol-initiated, electrolytes, prepn. of ion-conducting and amorphous)				
IT	Acrylic <b>polymers</b> , preparation <b>Urethane polymers</b> , preparation RL: <b>PREP (Preparation)</b> ( <b>polyoxyalkylene</b> -, polyol-initiated, <b>electrolytes</b> , prepn. of ion-conducting and amorphous)				
IT	50-70-4D, Sorbitol, ether with mixed oxirane compds., methacrylated, <b>polymers</b> , lithium complexes 79-41-4D, ester with <b>polymers</b> of C12 .alpha.-olefin oxide and glycidyl ether initiated by sorbitol, <b>polymers</b> , lithium complex 80-05-7D,				

ether with mixed oxirane compds., **polymers**, **polymer**  
 with **polyisocyanates**, **lithium** complexes 107-21-1D,  
 1,2-Ethanediol, ether with mixed oxirane compds., methacrylated,  
**polymers**, **lithium** complexes **822-06-0D**,  
**polymers** with polyether-polyols, **lithium** complex  
 930-37-0D, Methyl glycidyl ether, **polymers** with C4  
 .alpha.-olefin oxide, ether with diols, methacrylated, **polymers**,  
**lithium** complexes 4067-16-7D, Pentaethylenehexamine, ether with  
 mixed oxirane compds., methacrylated, **polymers**, **lithium**  
 complexes **7439-93-2D**, **Lithium**, polyether-polyol-based  
**polymer** complexes 14435-47-3D, **polymers** with C6  
 .alpha.-olefin oxide, ether with polyamines, methacrylated,  
**polymers**, **lithium** complexes 40349-67-5D,  
**polymers** with C12 .alpha.-olefin oxide, ether with sorbitol,  
 methacrylates, **polymers**, **lithium** complexes  
 134966-38-4D, **polymers** with C12 .alpha.-olefin oxide, ether with  
 polyamines, methacrylated, **polymers**, **lithium** complexes  
 142661-73-2D, **lithium** complex 142743-34-8D, **lithium**  
 complex 142743-35-9D, **lithium** complex 142743-36-0D,  
**lithium** complex 142953-73-9D, **lithium** complex  
 142953-74-0D, **lithium** complex

RL: USES (Uses)

(**electrolytes**, prepn. of ion-conducting and amorphous)

IT 96-48-0 108-32-7, Propylene carbonate

RL: USES (Uses)

(solvents, for amorphous polypolyoxyalkylene-polyol-based acrylic  
 polymers or **urethane** polymer **lithium** complexes)

IT **822-06-0D**, **polymers** with polyether-polyols,  
**lithium** complex **7439-93-2D**, **Lithium**,  
 polyether-polyol-based **polymer** complexes

RL: USES (Uses)

(**electrolytes**, prepn. of ion-conducting and amorphous)

RN 822-06-0 HCAPLUS

CN Hexane, 1,6-diisocyanato- (9CI) (CA INDEX NAME)

OCN- (CH<sub>2</sub>)<sub>6</sub>-NCO

RN 7439-93-2 HCAPLUS

CN Lithium (7CI, 8CI, 9CI) (CA INDEX NAME)

Li

L21 ANSWER 31 OF 44 HCAPLUS COPYRIGHT 2003 ACS

AN 1992:84807 HCAPLUS

DN 116:84807

TI Solid **polymer electrolytes** of **lithium** salts  
 and polyethylene glycols **crosslinked** with a siloxane-based  
**tetraisocyanate**

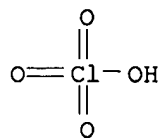
AU Xia, Du Wei; Zhou, Guangbin; Smid, Johannes

CS Coll. Environ. Sci. For., State Univ. New York, Syracuse, NY, 13210, USA

SO Integr. Fundam. Polym. Sci. Technol.--5, [Proc. Int. Meet. Polym. Sci.  
 Technol., Rolduc Polym. Meet.--5], 5th (1991), Meeting Date 1990, 395-9.  
 Editor(s): Lemstra, P. J.; Kleintjens, L. A. Publisher: 44-50, London, UK.

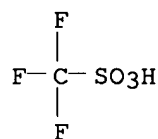
CODEN: 57HAAD

- DT Conference  
 LA English  
 CC 37-5 (Plastics Manufacture and Processing)  
 Section cross-reference(s): 52, 76
- AB Solvent-free electrolyte complexes with elec. cond. ( $\sigma$ ) approaching  $10^{-3}$  S/cm at 90.degree. were formed when LiClO<sub>4</sub> or LiCF<sub>3</sub>SO<sub>3</sub> are solubilized in networks of polyoxyethylenes and an aliph. **tetraisocyanate** made from .alpha.,.alpha.-di-Me m-isopropenylbenzyl **isocyanate** and cyclotetrasiloxane. The value of  $\sigma$  increased to close to  $10^{-2}$  S/cm on adding 30 wt% propylene carbonate, while the room-temp.  $\sigma$  reached  $2 \times 10^{-3}$  S/cm.
- ST **lithium siloxane isocyanate polyoxyethylene** electrolyte; solid polyelectrolyte **polyoxyethylene** network cond
- IT Electric conductors, polymeric  
 (**isocyanate**-contg. siloxane-**crosslinked polyoxyethylene lithium** complex networks, prepn. and performance of)
- IT Electric conductivity and conduction  
 (of **isocyanate**-contg. siloxane-**crosslinked polyoxyethylene lithium** complex networks)
- IT Glass temperature and transition  
 (of **isocyanate**-contg. siloxane-**crosslinked polyoxyethylene lithium** complex networks, elec. cond. in relation to)
- IT Cyclosiloxanes  
 RL: **SPN (Synthetic preparation); PREP (Preparation)**  
 (Me, **isocyanate** group-contg., tetrafunctional, **polymers** with polyoxyethylenes, solid **electrolytes** from, prepn. and cond. of)
- IT Polyelectrolytes  
 (solid, from **isocyanate**-contg. siloxane-**crosslinked polyoxyethylene lithium** complex networks, prepn. and cond. of)
- IT **7791-03-9DP, Lithium perchlorate**, complexes with **isocyanate**-contg. siloxane-**crosslinked** polyoxyethylenes  
**33454-82-9DP, Lithium triflate**, complexes with **isocyanate**-contg. siloxane-**crosslinked** polyoxyethylenes  
**138855-09-1DP, lithium** complexes  
 RL: **SPN (Synthetic preparation); PREP (Preparation)**  
 (networks, solid electrolytes from, prepn. and cond. of)
- IT **7791-03-9DP, Lithium perchlorate**, complexes with **isocyanate**-contg. siloxane-**crosslinked** polyoxyethylenes  
**33454-82-9DP, Lithium triflate**, complexes with **isocyanate**-contg. siloxane-**crosslinked** polyoxyethylenes  
 RL: **SPN (Synthetic preparation); PREP (Preparation)**  
 (networks, solid electrolytes from, prepn. and cond. of)
- RN 7791-03-9 HCAPLUS
- CN Perchloric acid, lithium salt (8CI, 9CI) (CA INDEX NAME)



Li

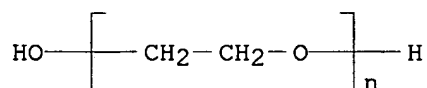
RN 33454-82-9 HCAPLUS  
 CN Methanesulfonic acid, trifluoro-, lithium salt (8CI, 9CI) (CA INDEX NAME)



Li

L21 ANSWER 32 OF 44 HCAPLUS COPYRIGHT 2003 ACS  
 AN 1991:619912 HCAPLUS  
 DN 115:219912  
 TI Synthesis and conducting properties of solid **polymer electrolytes** of **lithium** salts and polyethylene glycols **crosslinked** with a siloxane-based **tetraisocyanate**  
 AU Xia, Du Wei; Smid, Johannes  
 CS Coll. Environ. Sci. For., State Univ. New York, Syracuse, NY, 13210, USA  
 SO Polymer Preprints (American Chemical Society, Division of Polymer Chemistry) (1991), 32(1), 168-9  
 CODEN: ACPPAY; ISSN: 0032-3934  
 DT Journal  
 LA English  
 CC 76-2 (Electric Phenomena)  
 Section cross-reference(s): 35, 38  
 AB The synthesis and conducting properties of LiClO<sub>4</sub> and CF<sub>3</sub>SO<sub>3</sub>Li-contg. networks of polyethylene glycols are reported. A siloxane-based aliph. **isocyanate** was the **crosslinking** agent of choice. In a no. of systems polyethylene glycols with terminal amino groups ("Jeffamines") were used. With propylene carbonate added, conductivities close to 10<sup>-2</sup> cm<sup>-1</sup> at 90.degree. were recorded.  
 ST **polymer electrolyte lithium salt; polyethylene glycol crosslinking siloxane isocyanate**  
 IT Siloxanes and Silicones, uses and miscellaneous  
 RL: **PREP (Preparation)**  
 (lithium salt electrolytes, prepn. of)  
 IT Electric conductors  
 (lithium salts of poly(ethylene glycol) **crosslinked** with siloxanes)

- IT Electric conductivity and conduction  
Glass temperature and transition  
(of **lithium** salt poly(ethylene glycol) **crosslinked**  
with siloxane)
- IT Polymerization  
(of poly(ethylene glycol) with siloxane-based **tetraisocyanate**  
in conductor prepn.)
- IT 563-79-1, Tetramethylethylene 35147-35-4, Dibutyldilauryltin  
RL: CAT (Catalyst use); USES (Uses)  
(catalyst, for polymn. of siloxane-based **tetraisocyanate** with  
**polyethylene glycol**)
- IT **25322-68-3**, Polyethyleneglycol  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(**crosslinking** of, with siloxane for conductor prepn.)
- IT 70939-81-0  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(**crosslinking** of, with **tetraisocyanate** in  
conducting polymer prepn.)
- IT 2094-99-7  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(hydrosilylation of, in conducting polymer prepn.)
- IT 2370-88-9, Tetramethylcyclotetrasiloxane  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(hydrosilylation of, with .alpha.,.alpha.-dimethyl-m-isopropenylbenzyl  
**isocyanate**)
- IT **7439-93-2D**, **Lithium**, salts  
RL: USES (Uses)  
(in conductor polymer prepn.)
- IT 70939-81-0D, tetracyclosiloxane complex with  
RL: USES (Uses)  
(in **lithium** salt **crosslinked polyethylene**  
**glycol** siloxane-based **tetraisocyanate** polymer prepn.)
- IT 124219-73-4P  
RL: RCT (Reactant); **PREP (Preparation)**; RACT (Reactant or  
reagent)  
(prepn. and polymn. of, for polymeric conductor prepn.)
- IT 124219-73-4DP, poly(ethylene oxide) diether complex with  
RL: **PREP (Preparation)**  
(prepn. of conductor of)
- IT **25322-68-3**, Polyethyleneglycol  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(**crosslinking** of, with siloxane for conductor prepn.)
- RN 25322-68-3 HCAPLUS
- CN Poly(oxy-1,2-ethanediyl), .alpha.-hydro-.omega.-hydroxy- (9CI) (CA INDEX  
NAME)



- IT **7439-93-2D**, **Lithium**, salts  
RL: USES (Uses)  
(in conductor polymer prepn.)
- RN 7439-93-2 HCAPLUS
- CN **Lithium** (7CI, 8CI, 9CI) (CA INDEX NAME)

Li

L21 ANSWER 33 OF 44 HCAPLUS COPYRIGHT 2003 ACS

AN 1991:572418 HCAPLUS

DN 115:172418

TI Solid **electrolyte** comprising **urethane-crosslinked acrylic polymer**

IN Ido, Shuichi; Imachi, Hiroshi; Noda, Tomohiko

PA Yuasa Battery Co., Ltd., Japan

SO Jpn. Kokai Tokkyo Koho, 3 pp.

CODEN: JKXXAF

DT Patent

LA Japanese

IC ICM H01B001-12

ICS C08F299-00; H01M006-18; H01M010-40

CC 76-2 (Electric Phenomena)

Section cross-reference(s): 38

FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	JP 03084807	A2	19910410	JP 1989-220783	19890828
PRAI	JP 1989-220783		19890828		

AB The title **electrolyte**, contg. an ionic salt and a compd. which dissolves the salt, comprises a **crosslinked acryloyl compd. polymer** network having a **urethane** part. The electrolyte is useful for electrochem. devices, e.g. a **battery**, an electrochromic display, a sensor, an elec. capacitor, etc. Thus, a soln. contg. 2-hydroxyethanol-**diisocyanate** copolymer diacrylate, poly(ethylene oxide) diacrylate, **Li** trifluoromethanesulfonate, benzophenone, and propylene carbonate was cast on a glass plate and UV-irradiated to give an ion-conductive film showing bending strength.

ST solid **polymer electrolyte** acrylic **polyurethane**; **polyethylene oxide** acrylate copolymer **crosslinking**; **polyoxyalkylene polyurethane** acrylic electrolyte; ionic salt doped **polymer electrolyte**; **lithium** fluoromethanesulfonate doped **polymer electrolyte**; propylene carbonate doped solid electrolyte; bending strength network **crosslinked** electrolyte

IT Polyelectrolytes  
(**urethane-crosslinked** acrylic, ionic salt-doped, with bending strength)

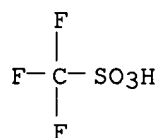
IT **Urethane polymers**, uses and miscellaneous  
RL: TEM (Technical or engineered material use); USES (Uses)  
(acrylic-**polyoxyalkylene-**, **crosslinked**, ionic salt-doped, **electrolyte**, with bending strength)

IT **Polyoxyalkylenes**, uses and miscellaneous  
RL: TEM (Technical or engineered material use); USES (Uses)  
(acrylic-**polyurethane-**, **crosslinked**, ionic salt-doped, electrolyte, with bending strength)

IT Acrylic **polymers**, uses and miscellaneous  
RL: TEM (Technical or engineered material use); USES (Uses)  
(**polyoxyalkylene-polyurethane-**, **crosslinked**, ionic salt-doped, **electrolyte**, with bending strength)

IT **33454-82-9, Lithium** trifluoromethanesulfonate  
RL: PEP (Physical, engineering or chemical process); TEM (Technical or

engineered material use); PROC (Process); USES (Uses)  
 (dopant, for **urethane-crosslinked** acrylic  
**polymer**, for **electrolyte**, with bending strength)  
 IT 26570-48-9DP, reaction products with **isocyanate** acrylates  
 RL: **PREP (Preparation)**  
 (prepn. of, ionic salt-doped, electrolyte, with bending strength)  
 IT 108-32-7, Propylene carbonate  
 RL: TEM (Technical or engineered material use); USES (Uses)  
 (solvent, for ionic salt, for acrylic **polyurethane**  
 electrolyte)  
 IT **33454-82-9, Lithium** trifluoromethanesulfonate  
 RL: PEP (Physical, engineering or chemical process); TEM (Technical or  
 engineered material use); PROC (Process); USES (Uses)  
 (dopant, for **urethane-crosslinked** acrylic  
**polymer**, for **electrolyte**, with bending strength)  
 RN 33454-82-9 HCAPLUS  
 CN Methanesulfonic acid, trifluoro-, lithium salt (8CI, 9CI) (CA INDEX NAME)



Li

L21 ANSWER 34 OF 44 HCAPLUS COPYRIGHT 2003 ACS  
 AN 1991:250699 HCAPLUS  
 DN 114:250699  
 TI Ion-conductive **polymer electrolyte**  
 IN Motogami, Kenji; Mori, Shigeo  
 PA Daiichi Kogyo Seiyaku Co., Ltd., Japan  
 SO Eur. Pat. Appl., 18 pp.  
 CODEN: EPXXDW  
 DT Patent  
 LA English  
 IC ICM H01M006-18  
 ICS H01B001-12  
 CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
 Section cross-reference(s): 38, 74, 76

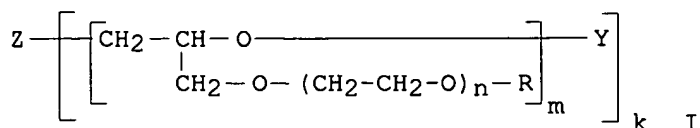
FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	EP 392839	A2	19901017	EP 1990-303944	19900411
	EP 392839	A3	19911127		
	EP 392839	B1	19950712		
	R: DE, FR, GB, NL				
	JP 03047833	A2	19910228	JP 1990-32237	19900213
	JP 2762145	B2	19980604		
	JP 03200863	A2	19910902	JP 1990-59132	19900309
	US 5116541	A	19920526	US 1990-507143	19900410
	CA 2014442	AA	19901013	CA 1990-2014442	19900411
PRAI	JP 1989-93763		19890413		

JP 1989-280723

19891026

GI



- AB The **electrolyte** comprises a **polymer** and a sol. salt, where the **polymer** is obtained by **crosslinking** a compd. I having an av. mol. wt. 1000-20,000 with an **isocyanate** compd. or by itself, where Z is a residue of a compd. having .gtoreq.1 active H, Y is H or **polymerizable** functional group, m = 1-250, n .ltoreq.25, k = 1-12, and R is a C1-20 alkyl, alkenyl, aryl, or alkylaryl.;. The electrolyte salt is selected from **Li**, Na, K, Cs, Ag, Cu, and/or Mg inorg. or org. salts. The electrolyte is suitable for various applications such as in **batteries**, electrochromic devices, etc. The ionic cond. of the invention electrolyte is excellent and its superiority becomes remarkable at low temps.
- ST ion conductive **polymer electrolyte**; **battery polymer electrolyte**; electrochromic device **polymer electrolyte**; cond ionic **polymer electrolyte**
- IT **Batteries**, primary  
**Batteries**, secondary  
 (polymer electrolytes for, ion-conductive)
- IT Optical imaging devices  
 (electrochromic, **polymer electrolytes** for, ion-conductive)
- IT Electric conductivity and conduction  
 (ionic, of **polymer electrolytes**, for **batteries** and electrochromic devices)
- IT 7439-93-2D, Lithium, complexes with **polyoxyalkylene-polyurethane** or **polyoxyalkylene**-acrylic copolymers 7439-95-4D, Magnesium, complexes with **polyoxyalkylene-polyurethane** or **polyoxyalkylene**-acrylic copolymers 7440-09-7D, Potassium, complexes with **polyoxyalkylene-polyurethane** or **polyoxyalkylene**-acrylic copolymers 7440-22-4D, Silver, complexes with **polyoxyalkylene-polyurethane** or **polyoxyalkylene**-acrylic copolymers 7440-23-5D, Sodium, complexes with **polyoxyalkylene-polyurethane** or **polyoxyalkylene**-acrylic copolymers 7440-46-2D, Cesium, complexes with **polyoxyalkylene-polyurethane** or **polyoxyalkylene**-acrylic copolymers 7440-50-8D, Copper, complexes with **polyoxyalkylene-polyurethane** or **polyoxyalkylene**-acrylic copolymers 134196-41-1D, complexes with alkali or alk. earth metals 134196-42-2D, complexes with alkali or alk. earth metals 134196-43-3D, complexes with alkali or alk. earth metals 134196-44-4D, complexes with alkali or alk. earth metals 134196-45-5D, complexes with alkali or alk. earth metals 134196-46-6D, complexes with alkali or alk. earth metals 134196-47-7D, complexes with alkali or alk. earth metals 134196-48-8D, complexes with alkali or alk. earth metals 134196-49-9D, complexes with alkali or alk. earth metals 134196-50-2D, complexes with



alkali or alk. earth metals 134247-92-0D, complexes with alkali or alk. earth metals 134247-93-1D, complexes with alkali or alk. earth metals 134247-94-2D, complexes with alkali or alk. earth metals 134247-95-3D, complexes with alkali or alk. earth metals 134247-96-4D, complexes with alkali or alk. earth metals

RL: DEV (Device component use); USES (Uses)

(electrolytes, for **batteries** and electrochromic devices)

IT 7439-93-2D, Lithium, complexes with

**polyoxyalkylene-polyurethane** or **polyoxyalkylene**-acrylic copolymers

RL: DEV (Device component use); USES (Uses)

(electrolytes, for **batteries** and electrochromic devices)

RN 7439-93-2 HCAPLUS

CN Lithium (7CI, 8CI, 9CI) (CA INDEX NAME)

Li

L21 ANSWER 35 OF 44 HCAPLUS COPYRIGHT 2003 ACS

AN 1991:65835 HCAPLUS

DN 114:65835

TI Ionic conductive **polymer electrolyte** and **lithium batteries** using the **electrolyte**

IN Shakushiro, Kiyoaki; Nagai, Ryo; Kawakami, Akira

PA Hitachi Maxell, Ltd., Japan

SO Eur. Pat. Appl., 13 pp.

CODEN: EPXXDW

DT Patent

LA English

IC ICM H01M006-18

ICS H01B001-12

CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
Section cross-reference(s): 38, 74, 76

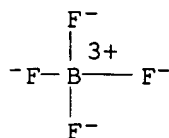
FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	EP 378123	A1	19900718	EP 1990-100195	19900105
	EP 378123	B1	19960911		
	R: DE, GB				
	JP 02291603	A2	19901203	JP 1989-343598	19891229
	US 5227043	A	19930713	US 1990-460252	19900102
PRAI	JP 1989-1767		19890107		
	JP 1989-1768		19890107		

AB The **electrolyte** comprises a **crosslinked Si-contg. polymer** and an alkali metal salt and has an ionic cond. of .gtoreq.10<sup>-5</sup> s/cm at 25.degree.. The polymer comprises .gtoreq.20 wt.% alkylene oxide (ethylene oxide) units, and the Si atom in the polymer is present as SiCH<sub>2</sub>CHR(CH<sub>2</sub>)<sub>p</sub>, SiOCHRCH<sub>2</sub>, SiCH<sub>2</sub>CHRCO, or SiOSiO, where R is H or Me and p is 0 or 1. The polymer has a crystallinity .ltoreq.30% or is amorphous, has a glass transition temp. .ltoreq.-40.degree., and dynamic loss modulus .ltoreq.10<sup>9</sup> dyne/cm<sup>2</sup> at 25.degree.. **Batteries** using this **electrolyte** have **Li** or **Li** alloy anodes, and cathodes selected from chalcogenides, V oxides, Co oxides, Mn oxides, and conductive **polymers**. The electrolyte can also be used in electrochromic display devices and in **Li<sup>+</sup>** sensors.

ST **lithium battery polymer electrolyte**

- ; **polyoxyalkylene** silylalkyl ether **battery**  
electrolyte; cond **polyoxyalkylene** silylalkyl ether electrolyte
- IT **Batteries, primary**  
    **Batteries, secondary**  
        (lithium, **electrolytes** of alkali metal salt-contg.  
          **crosslinked** silicon-contg. **polymers** for)
- IT Electric conductivity and conduction  
    (of lithium fluoroborate-contg. **crosslinked**  
      silicon-contg. **polymer electrolytes**, for  
      **batteries** and electrochromic display devices)
- IT Optical imaging devices  
    (electrochromic, **electrolytes** of alkali metal salt-contg.  
      **crosslinked** silicon-contg. **polymers** for)
- IT **Polyoxyalkylenes**, compounds  
    RL: USES (Uses)  
        (ethers, silylalkyl, **polymers**, **electrolytes**, for  
          **batteries** and electrochromic display devices)
- IT **14283-07-9**  
    RL: USES (Uses)  
        (**electrolytes** contg. **crosslinked polymers**  
          of **polyoxyalkylenes** silylalkyl ethers and, for  
          **batteries** and electrochromic display devices)
- IT 111-34-2D, Butyl vinyl ether, reaction products with **polyethylene**  
    **glycol** silylalkyl ethers, **polymers**, lithium  
    complexes 694-53-1D, Phenylsilane, reaction products with  
    **polyethylene glycol** allyl ethers, vinyl derivs.,  
    **polymers**, lithium complexes 814-74-4D,  
    1,1,2-Trimethyldisilane, reaction products with **polyethylene**  
    **glycol** allyl ethers, vinyl derivs., **polymers**,  
    lithium complexes 822-06-0D, reaction products with  
    **polyethylene glycol** silylalkyl ethers, **polymers**  
    , lithium complexes 871-92-1D, reaction products with  
    **polyethylene glycol** allyl ethers, vinyl derivs.,  
    **polymers**, lithium complexes 2370-88-9D,  
    Tetramethylcyclotetrasiloxane, reaction products with **polyethylene**  
    **glycol** allyl ethers, vinyl derivs., **polymers**,  
    lithium complexes 4459-30-7D, reaction products with  
    **polyethylene glycol** allyl ethers, vinyl derivs.,  
    **polymers**, lithium complexes 7439-93-2D,  
    Lithium, complexes with **crosslinked polymers**  
    of **polyoxyalkylenes** silylalkyl ethers 17082-46-1D, reaction  
    products with **polyethylene glycol** allyl ethers, vinyl  
    derivs., **polymers**, lithium complexes 27274-31-3D,  
    **Polyethylene glycol** allyl ether, reaction products with  
    silanes, vinyl derivs., **polymers**, lithium complexes  
    131923-63-2D, reaction products with **polyethylene glycol**  
    allyl ethers, vinyl derivs., **polymers**, lithium  
    complexes  
    RL: USES (Uses)  
        (**electrolytes**, for **batteries** and electrochromic  
          display devices)
- IT **14283-07-9**  
    RL: USES (Uses)  
        (**electrolytes** contg. **crosslinked polymers**  
          of **polyoxyalkylenes** silylalkyl ethers and, for  
          **batteries** and electrochromic display devices)
- RN 14283-07-9 HCAPLUS
- CN Borate(1-), tetrafluoro-, lithium (8CI, 9CI) (CA INDEX NAME)

Li<sup>+</sup>

IT 822-06-0D, reaction products with **polyethylene glycol** silylalkyl ethers, **polymers**, **lithium** complexes 7439-93-2D, **Lithium**, complexes with **crosslinked polymers** of **polyoxyalkylenes** silylalkyl ethers  
 RL: USES (Uses)  
 (electrolytes, for batteries and electrochromic display devices)

RN 822-06-0 HCAPLUS

CN Hexane, 1,6-diisocyanato- (9CI) (CA INDEX NAME)

OCN- (CH<sub>2</sub>)<sub>6</sub>-NCO

RN 7439-93-2 HCAPLUS

CN Lithium (7CI, 8CI, 9CI) (CA INDEX NAME)

Li

L21 ANSWER 36 OF 44 HCAPLUS COPYRIGHT 2003 ACS

AN 1990:615312 HCAPLUS

DN 113:215312

TI **Polymer solid electrolytes**

IN Yoneyama, Sachiko; Osawa, Toshuki; Kimura, Okitoshi; Kahata, Toshiyuki

PA Ricoh Co., Ltd., Japan

SO Jpn. Kokai Tokkyo Koho, 6 pp.  
 CODEN: JKXXAF

DT Patent

LA Japanese

IC ICM H01M010-40  
 ICS G02F001-15; H01G009-02

CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
 Section cross-reference(s): 38, 74, 76

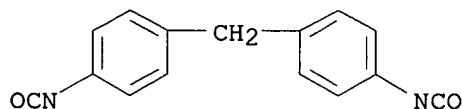
FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	JP 02005370	A2	19900110	JP 1988-141585	19880610
	JP 2941812	B2	19990830		
PRAI	JP 1987-301587		19871201		

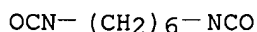
AB The **electrolytes** have a matrix of **crosslinked** PEO having A1280/A842 ratio .ltoreq.0.80, where A1280 and A840 are the

absorptance of the **polymer** at 1280/cm and 842/cm of its IR spectrum, resp. The electrolytes have high ionic cond. and mech. strength, and are useful for secondary **batteries**, electrochromic devices, and capacitors.

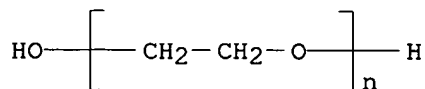
- ST PEO **crosslinked** solid electrolyte matrix; **battery** electrolyte **crosslinked** PEO matrix; electrochromic device electrolyte **crosslinked** PEO; capacitor electrolyte **crosslinked** PEO matrix
- IT **Batteries**, secondary  
Electric capacitors  
(solid electrolytes with **crosslinked** PEO matrixes for)
- IT Optical imaging devices  
(electrochromic, solid electrolytes with **crosslinked** PEO matrixes for)
- IT 101-68-8D, **polymers** with **polyoxyethylene** triols, **lithium** complexes 614-90-4D, **polymers** with **polyoxyethylene** triols, **lithium** complexes 822-06-0D, **polymers** with **polyoxyethylene** triols, **lithium** complexes 2422-91-5D, **polymers** with **polyoxyethylene** triols, **lithium** complexes 2761-22-0D, **polymers** with **polyoxyethylene** triols, **lithium** complexes 4747-90-4D, **polymers** with **polyoxyethylene** triols, **lithium** complexes 25322-68-3D, triol ethers, **polymers** with **isocyanates**, **lithium** complexes  
RL: USES (Uses)  
(electrolytes, for **batteries** and electrochromic devices and capacitors)
- IT 7791-03-9, **Lithium** perchlorate 14283-07-9, **Lithium** tetrafluoroborate 33454-82-9, **Lithium** trifluoromethanesulfonate  
RL: USES (Uses)  
(electrolytes, in **crosslinked** PEO matrixes, for **batteries** and electrochromic devices and capacitors)
- IT 101-68-8D, **polymers** with **polyoxyethylene** triols, **lithium** complexes 822-06-0D, **polymers** with **polyoxyethylene** triols, **lithium** complexes 25322-68-3D, triol ethers, **polymers** with **isocyanates**, **lithium** complexes  
RL: USES (Uses)  
(electrolytes, for **batteries** and electrochromic devices and capacitors)
- RN 101-68-8 HCAPLUS
- CN Benzene, 1,1'-methylenebis[4-isocyanato- (9CI) (CA INDEX NAME)



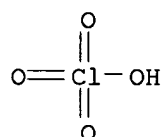
- RN 822-06-0 HCAPLUS
- CN Hexane, 1,6-diisocyanato- (9CI) (CA INDEX NAME)



RN 25322-68-3 HCAPLUS  
 CN Poly(oxy-1,2-ethanediyl), .alpha.-hydro-.omega.-hydroxy- (9CI) (CA INDEX NAME)

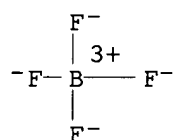


IT 7791-03-9, Lithium perchlorate 14283-07-9,  
 Lithium tetrafluoroborate 33454-82-9, Lithium  
 trifluoromethanesulfonate  
 RL: USES (Uses)  
 (electrolytes, in **crosslinked** PEO matrixes, for  
**batteries** and electrochromic devices and capacitors)  
 RN 7791-03-9 HCAPLUS  
 CN Perchloric acid, lithium salt (8CI, 9CI) (CA INDEX NAME)



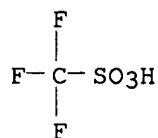
Li

RN 14283-07-9 HCAPLUS  
 CN Borate(1-), tetrafluoro-, lithium (8CI, 9CI) (CA INDEX NAME)



Li<sup>+</sup>

RN 33454-82-9 HCAPLUS  
 CN Methanesulfonic acid, trifluoro-, lithium salt (8CI, 9CI) (CA INDEX NAME)



Li

L21 ANSWER 37 OF 44 HCAPLUS COPYRIGHT 2003 ACS  
 AN 1990:182903 HCAPLUS  
 DN 112:182903  
 TI Secondary **batteries** and electrochromic display devices  
 IN Yoneyama, Sachiko; Ohsawa, Toshiyuki; Kimura, Okitoshi; Kabata, Toshiyuki  
 PA Ricoh Co., Ltd., Japan  
 SO Ger. Offen., 12 pp.  
 CODEN: GWXXBX  
 DT Patent  
 LA German  
 IC ICM H01M006-12  
 ICS H01M006-18; H01M010-38; G02F001-17; H01G009-02  
 ICA C03C003-00; C04B035-10; C04B035-46; C08L023-06; C08L025-02; C08L033-12;  
 C08L071-02; C08L077-00  
 CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
 Section cross-reference(s): 37, 38, 57, 74

FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	DE 3920129	A1	19891228	DE 1989-3920129	19890620
	DE 3920129	C2	19910221		
	JP 01319268	A2	19891225	JP 1988-151110	19880621
	US 5011751	A	19910430	US 1989-369122	19890621
	JP 02155173	A2	19900614	JP 1989-204582	19890809
	JP 3062203	B2	20000710		
PRAI	JP 1988-151110	A	19880621		
	JP 1988-197173	A	19880809		

OS MARPAT 112:182903

AB **Batteries** and electrochromic display devices have .gtoreq.1 pair of electrodes sandwiching a solid **polymeric electrolyte**. The electrolyte contains a salt and .apprx.0.1-50 vol.% dispersed spherical ion-conductive particles of uniform size (diam. 0.1-50 .mu.m) and having an electron cond. of .ltoreq.10-10 S/cm. The particles are made of polymers such as phenolic resins, **crosslinked** poly(divinylbenzene), poly(Me methacrylate, polystyrene, etc., or of inorg. materials such as crown glass, Nasicon, Lisicon, Al2O3, and TiO2. The electrolyte salt contains BR4- anions, where R is alkyl, Ph, or halogen.

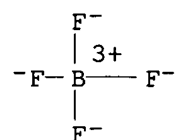
ST **battery** secondary **polymer electrolyte**; electrochromic device **polymer electrolyte**; haloborate **polymer electrolyte battery**; alkylborate **polymer electrolyte battery**; phenylborate **polymer electrolyte battery**; **polymer** haloborate **electrolyte battery**; oxide dispersion **polymer electrolyte battery**; glass dispersion

- polymer electrolyte battery**
- IT Optical imaging devices  
(electrochromic, solid **polymer electrolytes** for, dispersed spherical particles- and salt-contg.)
- IT **Batteries**, secondary  
(solid-electrolyte, **polymer electrolytes** for, dispersed spherical particles- and salt-contg.)
- IT **7439-93-2, Lithium**, uses and miscellaneous  
RL: USES (Uses)  
(anodes, in **batteries** with **polymer electrolytes**)
- IT 12039-13-3, Titanium sulfide (TiS<sub>2</sub>) 25233-30-1 30604-81-0  
RL: USES (Uses)  
(cathodes, in **batteries** with **polymer electrolytes**)
- IT 7440-57-5, Gold, uses and miscellaneous 50926-11-9, Indium tin oxide 84928-92-7  
RL: USES (Uses)  
(electrodes, in electrochromic devices with **polymer electrolytes**)
- IT 26570-48-9 126465-26-7, Micropearl SP 205  
RL: USES (Uses)  
(**electrolytes** contg. dispersed particles of, **polymer**, for **batteries**)
- IT 1344-28-1, Aluminum oxide (Al<sub>2</sub>O<sub>3</sub>), uses and miscellaneous 13463-67-7, Titanium oxide (TiO<sub>2</sub>), uses and miscellaneous 70780-99-3 77641-62-4, Nasicon  
RL: USES (Uses)  
(**electrolytes** contg. dispersed particles of, **polymer**, for **batteries** and electrochromic devices)
- IT 126465-27-8, Micropearl SP 214  
RL: USES (Uses)  
(**electrolytes** contg. dispersed particles of, **polymer**, for electrochromic devices)
- IT 7778-74-7 **14283-07-9** 14485-20-2  
RL: USES (Uses)  
(**electrolytes** contg. **polymers** and, dispersed **polymer** and ceramic particles in, for **batteries** and electrochromic devices)
- IT **584-84-9D, polymers** with polyoxyethylene triols, **lithium** complexes **25322-68-3D**, triol derivs., **polymers** with TDI, **lithium** complexes  
RL: USES (Uses)  
(**electrolytes**, contg. ceramic particles and propylene carbonate and tetrafluoroborate, for **batteries**)
- IT **7439-93-2D, Lithium, polymer** complexes  
7440-09-7D, Potassium, **polymer complexes**  
RL: USES (Uses)  
(**electrolytes**, contg. ceramic particles, for **batteries**)
- IT 24937-79-9D, Poly(vinylidene fluoride), **lithium** and potassium complexes  
RL: USES (Uses)  
(**electrolytes**, contg. dispersed divinylbenzene copolymer particles, for **batteries** and electrochromic devices)
- IT **7439-93-2, Lithium**, uses and miscellaneous  
RL: USES (Uses)  
(anodes, in **batteries** with **polymer**

**electrolytes)**  
 RN 7439-93-2 HCAPLUS  
 CN Lithium (7CI, 8CI, 9CI) (CA INDEX NAME)

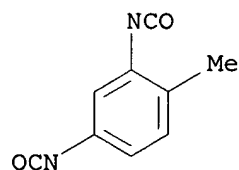
Li

IT **14283-07-9**  
 RL: USES (Uses)  
 (electrolytes contg. **polymers** and, dispersed  
**polymer** and ceramic particles in, for **batteries** and  
 electrochromic devices)  
 RN 14283-07-9 HCAPLUS  
 CN Borate(1-), tetrafluoro-, lithium (8CI, 9CI) (CA INDEX NAME)

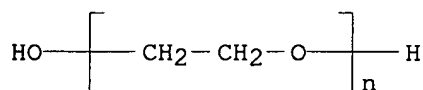


Li<sup>+</sup>

IT **584-84-9D, polymers with polyoxyethylene**  
 triols, **lithium** complexes **25322-68-3D**, triol derivs.,  
**polymers** with TDI, lithium complexes  
 RL: USES (Uses)  
 (electrolytes, contg. ceramic particles and propylene  
 carbonate and tetrafluoroborate, for **batteries**)  
 RN 584-84-9 HCAPLUS  
 CN Benzene, 2,4-diisocyanato-1-methyl- (9CI) (CA INDEX NAME)



RN 25322-68-3 HCAPLUS  
 CN Poly(oxy-1,2-ethanediyl), .alpha.-hydro-.omega.-hydroxy- (9CI) (CA INDEX NAME)



IT **7439-93-2D, Lithium, polymer complexes**  
 RL: USES (Uses)



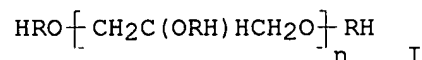
(electrolytes, contg. ceramic particles, for  
batteries)

RN 7439-93-2 HCAPLUS  
CN Lithium (7CI, 8CI, 9CI) (CA INDEX NAME)

Li

L21 ANSWER 38 OF 44 HCAPLUS COPYRIGHT 2003 ACS  
AN 1989:646065 HCAPLUS  
DN 111:246065  
TI **Lithium ion conductive polymer electrolytes**  
IN Akashiro, Kyoaki; Nagai, Tatsu; Manabe, Toshikatsu  
PA Hitachi Maxell, Ltd., Japan  
SO Jpn. Kokai Tokkyo Koho, 7 pp.  
CODEN: JKXXAF  
DT Patent  
LA Japanese  
IC ICM H01M010-40  
ICS H01M006-18  
CC 76-2 (Electric Phenomena)  
Section cross-reference(s): 35, 52  
FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	JP 01107473	A2	19890425	JP 1987-265810	19871020
PRAI	JP 1987-265810		19871020		
GI					

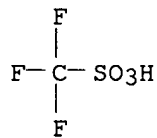


AB In a **Li ion conductive polymer electrolyte** comprising a **Li salt** and an org. **polymer**, the org. **polymer** is an adduct I of polyglycerin and poly(ether glycol) (R = **polyethylene glycol, polypropylene glycol**, ethylene oxide-propylene oxide copolymer; n .ltoreq. 50) and optionally **crosslinked** with a **crosslinking agent**. The electrolyte has high **Li ion cond.** and is in solid phase at room temp., and useful for **Li batteries**, electrochromic display devices, **Li ion sensors**, **Li ion sepn. membranes**, etc. A soln. mixt. contg. Unigly AV 645 [polyglycerin-poly(ether glycol) adduct] and 2,4-tolylene **diisocyanate** was dropwise spread on an Al substrate, reacted at 80.degree. for 8 h in Ar flow to give a block copolymer, which was immersed in LiCF3SO3-contg. acetone to impregnate LiCF3SO3 in the block copolymer and give an electrolyte having high ion cond.

ST **lithium ion conductor polymer electrolyte;**  
**battery electrolyte ion conductor polymer;**  
polyglycerin alkylene oxide adduct electrolyte

IT **Batteries**, primary  
Electric conductors  
(**lithium ion conductive polymer**)

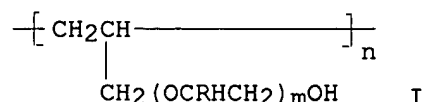
electrolytes for)  
 IT **Electrolytes**  
 (lithium ion conductive **polymers** for)  
 IT Optical imaging devices  
 (electrochromic, **lithium** ion conductive **polymer**  
**electrolytes** for)  
 IT 88651-88-1 124036-74-4  
 RL: DEV (Device component use); USES (Uses)  
 (ion conductive electrolyte of, doped with **lithium** salt, for  
**batteries** and electrochromic display devices)  
 IT **33454-82-9**  
 RL: DEV (Device component use); USES (Uses)  
 (**polymer electrolyte** doped with, for  
**lithium** ion cond., for **batteries** and electrochromic  
 display devices)  
 IT **33454-82-9**  
 RL: DEV (Device component use); USES (Uses)  
 (**polymer electrolyte** doped with, for  
**lithium** ion cond., for **batteries** and electrochromic  
 display devices)  
 RN 33454-82-9 HCAPLUS  
 CN Methanesulfonic acid, trifluoro-, lithium salt (8CI, 9CI) (CA INDEX NAME)



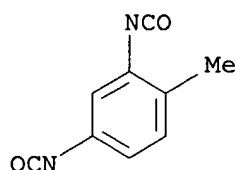
Li

L21 ANSWER 39 OF 44 HCAPLUS COPYRIGHT 2003 ACS  
 AN 1989:607398 HCAPLUS  
 DN 111:207398  
 TI **Lithium** ion conductive **polymer electrolytes**  
 IN Akashiro, Kyoaki; Nagai, Tatsu; Manabe, Toshikatsu  
 PA Hitachi Maxell, Ltd., Japan  
 SO Jpn. Kokai Tokkyo Koho, 7 pp.  
 CODEN: JKXXAF  
 DT Patent  
 LA Japanese  
 IC ICM H01M010-40  
 ICS H01M006-18  
 CC 76-2 (Electric Phenomena)  
 Section cross-reference(s): 35, 52  
 FAN.CNT 1

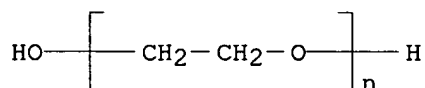
	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
	-----	---	-----	-----	-----
PI	JP 01107474	A2	19890425	JP 1987-265811	19871020
PRAI	JP 1987-265811		19871020		
GI					



- AB In a **Li ion conductive polymer electrolyte** comprising a **Li salt** and an org. **polymer**, the org. **polymer** is a vinyl **polymd.** allylated polyether glycol I ( $R = \text{H, Me}$ ;  $m = 3-360$ ;  $n = 2-40$ ) optionally **crosslinked** with a **crosslinking agent**. The electrolyte has high **Li ion** cond. at room temp. and is useful for **Li batteries**, electrochromic display devices, **Li ion** sensors, **Li ion** sepn. membranes, etc. A sticky soln. mixt. contg. polyallylated poly(ethylene glycol), which was prepd. by reaction of allylated poly(ethylene glycol) with azobisisobutyronitrile, and 2,4-tolylene **diisocyanate** was dropwise spread on an Al substrate, and reacted at 80.degree. for 8 h in Ar flow to give a block copolymer, which was immersed in  $\text{LiCF}_3\text{SO}_3$ -contg. acetone to impregnate  $\text{LiCF}_3\text{SO}_3$  in the block copolymer and give an electrolyte having high ion cond.
- ST **lithium ion conductor polymer electrolyte;**  
**battery electrolyte ion conductor polymer;**  
allylated **polyethylene glycol** block copolymer
- IT **Batteries**, primary  
Electric conductors  
(**lithium ion conductive polymer electrolytes** for)
- IT **Electrolytes**  
(**lithium ion conductive polymers** for)
- IT Optical imaging devices  
(electrochromic, **lithium ion conductive polymer electrolytes** for)
- IT **Urethane polymers**, uses and miscellaneous  
RL: DEV (Device component use); USES (Uses)  
(**polyoxyalkylene-**, ion conductive **electrolyte** of, doped with **lithium salt**, for **batteries** and electrochromic display devices)
- IT **584-84-9D**, reaction products with polyallylated poly(ethylene glycol) **25322-68-3D**, Poly(ethylene glycol), polyallylated, reaction products with 2,4-tolylene **diisocyanate**  
RL: DEV (Device component use); USES (Uses)  
(ion conductive electrolyte of, doped with **lithium salt**, for **batteries** and electrochromic display devices)
- IT 123524-39-0  
RL: DEV (Device component use); USES (Uses)  
(**polymer electrolyte** doped with, for **lithium ion cond.**, for **batteries** and electrochromic display devices)
- IT **584-84-9D**, reaction products with polyallylated poly(ethylene glycol) **25322-68-3D**, Poly(ethylene glycol), polyallylated, reaction products with 2,4-tolylene **diisocyanate**  
RL: DEV (Device component use); USES (Uses)  
(ion conductive electrolyte of, doped with **lithium salt**, for **batteries** and electrochromic display devices)
- RN 584-84-9 HCAPLUS
- CN Benzene, 2,4-diisocyanato-1-methyl- (9CI) (CA INDEX NAME)



RN 25322-68-3 HCAPLUS  
 CN Poly(oxy-1,2-ethanediyl), .alpha.-hydro-.omega.-hydroxy- (9CI) (CA INDEX NAME)



L21 ANSWER 40 OF 44 HCAPLUS COPYRIGHT 2003 ACS  
 AN 1989:557409 HCAPLUS  
 DN 111:157409  
 TI Radiation-cured solid electrolytes and **batteries** using these electrolytes  
 IN Lee, Mei Tsu; Shackle, Dale R.; Schwab, Gerhart  
 PA MHB Joint Venture, USA  
 SO U.S., 9 pp. Cont.-in-part of U.S. Ser. No. 115,492, abandoned.  
 CODEN: USXXAM  
 DT Patent  
 LA English  
 IC ICM H01M006-18  
 NCL 429192000  
 CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
 Section cross-reference(s): 38, 76

FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	US 4830939	A	19890516	US 1988-173385	19880325
	US 4830939	B1	19961008		
	JP 02000602	A2	19900105	JP 1988-270628	19881026
	DK 8806020	A	19890501	DK 1988-6020	19881028
	CN 1033126	A	19890524	CN 1988-107375	19881028
	CN 1039953	B	19980923		
	EP 318161	A1	19890531	EP 1988-310179	19881028
	EP 318161	B1	19941214		
	R: BE, DE, FR, GB, IT, NL, SE				
	EP 606117	A2	19940713	EP 1994-104165	19881028
	EP 606117	A3	19960612		
	EP 606117	B1	20011219		
	R: BE, DE, FR, GB, IT, NL, SE				
	CA 1339619	A1	19980106	CA 1988-581609	19881028
	US 5037712	A	19910806	US 1990-506408	19900406
	EP 450981	A1	19911009	EP 1991-303034	19910405
	EP 450981	B1	19950621		
	R: AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LI, LU, NL, SE				
	JP 05109310	A2	19930430	JP 1991-73149	19910405
	JP 2572897	B2	19970116		

	ES 2075346	T3	19951001	ES 1991-303034	19910405
	CA 2039836	AA	19911007	CA 1991-2039836	19910408
	US 5238758	A	19930824	US 1991-776722	19911015

PRAI US 1987-115492 A2 19871030  
 US 1988-173385 A 19880325  
 EP 1988-310179 A3 19881028  
 US 1989-326574 B2 19890321  
 US 1990-506408 A 19900406  
 US 1990-549658 B1 19900709

AB A mixt. of a liq. monomeric or prepolymeric radiation  
**polymerizable** ethylenically unsatd. compd., a radiation-inert  
 ionically conducting liq. (an aprotic polar solvent), and an ionizable  
 alkali metal salt is subjected to an actinic (UV or electron-beam)  
 radiation to **crosslink** the **polymerizable** material to  
 form a solid **electrolyte** matrix for use in **batteries**.  
 The polymerizable compd. is A[CH<sub>2</sub>C(R)(H)O]<sub>n</sub>A, A[CH<sub>2</sub>CH<sub>2</sub>N(R)]<sub>n</sub>A, or  
 A[CH<sub>2</sub>N(R)CH<sub>2</sub>]<sub>n</sub>A, where n is .apprx. 3-50, R is H or C1-3 alkyl group, and  
 A is an ethylenically unsatd. or a glycidyl moiety. The compd. is  
**polyethylene glycol** diacrylate, **polyethylene**  
**glycol** dimethacrylate, an acrylate functionalized  
**polyurethane**, or **polyethylene glycol**  
 diglycidyl ether. The ionically conducting liq. is present in the mixt.  
 at .gtoreq.45 wt.% and is **polyethylene glycol** di-Me  
 ether or an aprotic polar solvent selected from propylene carbonate,  
 .gamma.-butyrolactone, 1,3-dioxolane, and 2-methyltetrahydrofuran. The  
 anion of the salt is selected from I-, Br-, SCN-, ClO<sub>4</sub>-, CF<sub>3</sub>SO<sub>3</sub>-, BF<sub>4</sub>-,  
 PF<sub>6</sub>-, AsF<sub>6</sub>-, and CF<sub>3</sub>CO<sub>2</sub>-. Methods for forming anodes (Li),  
 cathodes (intercalation compd. such as V oxide), and **batteries**  
 using this polymeric network are also disclosed.

ST **battery electrolyte polymer** aprotic solvent;  
**polyethylene glycol** diacrylate **battery**  
 electrolyte; ether dimethyl **polyethylene glycol**  
 electrolyte; alkali metal salt **polymer electrolyte**;  
**lithium polymer electrolyte battery**  
 anode; vanadium oxide **polymer electrolyte** cathode;  
 electron beam radiation **polymer electrolyte**

IT Electron beam, chemical and physical effects  
 (in manuf. of **electrolytes** contg. aprotic polar solvents and  
**polymers**, for **batteries**)

IT **Batteries**, secondary  
 (lithium-vanadium oxide, with **polymer**-contg.  
**electrolytes**, manuf. of)

IT Electric conductivity and conduction  
 (ionic, of **lithium salt-polymer**-aprotic polar  
 solvent **electrolytes**)

IT Alkali metals, compounds  
 RL: USES (Uses)  
 (salts, **polymer** complexes, **electrolytes** contg.  
 aprotic polar solvents, for **batteries** and **battery**  
 electrodes)

IT 7439-93-2P, Lithium, uses and miscellaneous  
 RL: PREP (Preparation); USES (Uses)  
 (anodes, contg. electrolytes, manuf. of, for **batteries**)

IT 12037-42-2P, Vanadium oxide (V6013)  
 RL: PREP (Preparation)  
 (cathodes, contg. electrolytes, manuf. of, for **batteries**)

IT 96-47-9, 2-Methyltetrahydrofuran 96-48-0 108-32-7, Propylene carbonate  
 646-06-0, 1,3-Dioxolane 24991-55-7, **Polyethylene**

glycol dimethyl ether

RL: USES (Uses)

(electrolytes contg. lithium salt and polymer and, for batteries and battery electrodes)

IT 33454-82-9, Lithium trifluoromethanesulfonate

RL: USES (Uses)

(electrolytes contg. polymers and polyethylene glycol di-Me ether and, for batteries and battery electrodes)

IT 25852-47-5D, alkali metal complexes 26403-72-5D, Polyethylene glycol diglycidyl ether, alkali metal complexes

RL: USES (Uses)

(electrolytes, contg. aprotic polar solvent, for batteries and battery electrodes)

IT 7439-93-2D, Lithium, polymer complexes

26570-48-9D, Polyethylene glycol diacrylate, lithium complexes 122985-87-9D, Uvithane ZL 1178, lithium complexes 122988-77-6D, lithium complexes

RL: USES (Uses)

(electrolytes, contg. polyethylene glycol di-Me ether, for batteries and battery electrodes)

IT 7439-93-2P, Lithium, uses and miscellaneous

RL: PREP (Preparation); USES (Uses)

(anodes, contg. electrolytes, manuf. of, for batteries)

RN 7439-93-2 HCAPLUS

CN Lithium (7CI, 8CI, 9CI) (CA INDEX NAME)

Li

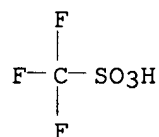
IT 33454-82-9, Lithium trifluoromethanesulfonate

RL: USES (Uses)

(electrolytes contg. polymers and polyethylene glycol di-Me ether and, for batteries and battery electrodes)

RN 33454-82-9 HCAPLUS

CN Methanesulfonic acid, trifluoro-, lithium salt (8CI, 9CI) (CA INDEX NAME)



Li

IT 7439-93-2D, Lithium, polymer complexes

RL: USES (Uses)

(electrolytes, contg. polyethylene glycol di-Me ether, for batteries and battery electrodes)

RN 7439-93-2 HCAPLUS

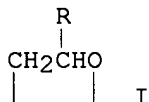
CN Lithium (7CI, 8CI, 9CI) (CA INDEX NAME)

Li

L21 ANSWER 41 OF 44 HCAPLUS COPYRIGHT 2003 ACS  
 AN 1989:118336 HCAPLUS  
 DN 110:118336  
 TI Novel macromolecular material for electrolytes and/or electrodes  
 IN Armand, Michel; Muller, Daniel; Duval, Michel; Harvey, Paul E.; Chabagno, Jean M.  
 PA Societe Nationale Elf Aquitaine (SNEA), Fr.; Hydro-Quebec  
 SO U.S., 5 pp. Cont.-in-part of U.S. 4,478,326.  
 CODEN: USXXAM  
 DT Patent  
 LA English  
 IC ICM H01M006-18  
 ICS H01M010-40  
 NCL 429192000  
 CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
 Section cross-reference(s): 38, 76  
 FAN.CNT 2

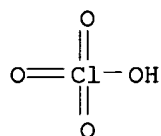
	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	US 4758483	A	19880719	US 1985-774915	19850911
	US 4578326	A	19860325	US 1984-584535	19840228
PRAI	US 1984-584535		19840228		
	ID 1983-9228		19830311		
	FR 1983-9886		19830615		

GI



AB The title amorphous, single-phase solid material of high ionic cond., thermodynamical stability, cation soly., and elasticity at ambient temp. comprises an ionizable salt (LiClO<sub>4</sub>, LiF<sub>3</sub>CSO<sub>3</sub>) and a **crosslinked** random polyether copolymer of ethylene oxide and a substituted ether I, where R is R<sub>1</sub> or -CH<sub>2</sub>OR<sub>2</sub>R<sub>1</sub> and R<sub>1</sub> is C<sub>1</sub>-12 alkyl, alkenyl, or alkynyl and R<sub>2</sub> is a polyether -(CH<sub>2</sub>CH<sub>2</sub>O)<sub>p</sub>- and a cyclic ether with a C>3 ring, where p is an integer <10. The salt content is .apprx.1.5-25 wt.%. The material is used as electrolyte in a **battery**. **Crosslinked**, amorphous alkyl glycidyl ether-ethylene oxide copolymer was prepd. and used in a secondary **battery** at a high utilization rate, which was const. over a large no. of cycles.  
 ST ethylene oxide copolymer **battery** electrolyte; ether oxide copolymer **battery** electrode; glycidyl alkyl ether copolymer **battery**  
 IT **Batteries**, primary  
     **Batteries**, secondary  
     (electrolytes from ethylene oxide-substituted ether oxide copolymers and **lithium** salts)

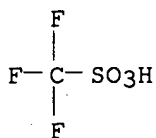
- IT Electric conductivity and conduction  
(ionic, of **lithium** perchlorate-contg. ethylene  
oxide-propylene oxide block copolymer, **crosslinked** amorphous,  
for **battery** electrolytes)
- IT 75-21-8D, Ethylene oxide, alkyl glycidyl ether copolymers 556-52-5D,  
Glycidol, alkyl ethers, ethylene oxide copolymers  
RL: USES (Uses)  
(**crosslinked**, amorphous elastomeric, for **battery**  
electrodes)
- IT **7791-03-9 33454-82-9**  
RL: USES (Uses)  
(electrolytes from **crosslinked** poly(alkylene oxides) and, for  
**batteries**)
- IT 75-79-6D, Methyltrichlorosilane, poly(alkylene oxides) **crosslinked**  
by **triisocyanates** and trialkylaluminum and 1070-00-4D,  
Trioctylaluminum, poly(alkylene oxides) **crosslinked** by  
**triisocyanates** and methyltrichlorosilane and 9003-11-6D,  
Ethylene oxide-propylene oxide copolymer, **polymers** with aliph.  
**triisocyanates crosslinked** with methyltrichlorosilane  
and trioctylaluminum **25322-68-3D**, Poly(ethylene oxide),  
**polymers** with aliph. **triisocyanates crosslinked**  
with methyltrichlorosilane and trioctylaluminum 106392-12-5D, Ethylene  
oxide-propylene oxide block copolymer, **polymers** with aliph.  
**triisocyanates crosslinked** with methyltrichlorosilane  
and trioctylaluminum  
RL: USES (Uses)  
(**electrolytes** from **lithium** salts and, for  
**batteries**)
- IT **7791-03-9 33454-82-9**  
RL: USES (Uses)  
(electrolytes from **crosslinked** poly(alkylene oxides) and, for  
**batteries**)
- RN 7791-03-9 HCAPLUS  
CN Perchloric acid, lithium salt (8CI, 9CI) (CA INDEX NAME)



● Li

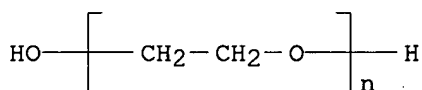
- RN 33454-82-9 HCAPLUS  
CN Methanesulfonic acid, trifluoro-, lithium salt (8CI, 9CI) (CA INDEX NAME)





Li

IT 25322-68-3D, Poly(ethylene oxide), **polymers** with aliph. **triisocyanates crosslinked** with methyltrichlorosilane and trioctylaluminum  
 RL: USES (Uses)  
 (electrolytes from lithium salts and, for batteries)  
 RN 25322-68-3 HCAPLUS  
 CN Poly(oxy-1,2-ethanediyl), .alpha.-hydro-.omega.-hydroxy- (9CI) (CA INDEX NAME)



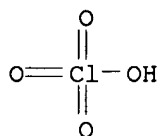
L21 ANSWER 42 OF 44 HCAPLUS COPYRIGHT 2003 ACS  
 AN 1988:553061 HCAPLUS  
 DN 109:153061  
 TI **Crosslinked** polyethers as media for ionic conduction  
 AU Le Nest, Jean Francois; Gandini, Alessandro; Cheradame, Herve  
 CS Lab. Chim. Macromol. Papetiere, Ec. Francaise Papeterie, Saint Martin d'Heres, 38402, Fr.  
 SO British Polymer Journal (1988), 20(3), 253-68  
 CODEN: BPOJAB; ISSN: 0007-1641  
 DT Journal  
 LA English  
 CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
 Section cross-reference(s): 37, 38, 76  
 AB A broad outline is given of a comprehensive investigation dealing with solid **polymeric electrolytes** contg. ionic species. These materials are based on various types of polyethers (homopolymers, block and graft copolymers) **crosslinked** via **urethane** chem. and either filled with a salt or transformed into ionomers with the anions attached to the chains. The properties studied were sp. vol., swelling, glass transition temp., viscoelasticity, ionic cond., transport nos., magnetic relaxation of nuclei from both the polymer chains and the ions, and redox stability. Mechanisms and models are proposed to explain chain partitioning by cations and the mode of ionic transport. An all-solid-state **battery** was prepd. with one of these materials to prove its good performance.  
 ST **battery electrolyte** ionic conducting **polymer** ; **crosslinked** polyether ionic conduction; salt **polymer electrolyte battery**; ionomer **polymer electrolyte battery**

- IT Glass temperature and transition  
Transference number  
(of **crosslinked** polyether electrolytes contg. **lithium**  
salt, for **batteries**)
- IT Electric conductors  
(**polymeric, crosslinked** polyethers contg.  
**lithium** salt, properties of, for **battery**  
**electrolytes**)
- IT Siloxanes and Silicones, compounds  
RL: USES (Uses)  
(di-Me, block, graft **polymers**, with ethylene oxide-propylene  
oxide - Desmodur R, metal complexes, **electrolytes**, contg.  
anions, properties of, for **batteries**)
- IT Electric conductivity and conduction  
(ionic, of **crosslinked** polyether electrolytes contg.  
**lithium** salt, for **batteries**)
- IT **Urethane polymers**, compounds  
RL: USES (Uses)  
(polyether-, metal complexes, **electrolytes**, contg. anions,  
properties of, for **batteries**)
- IT Siloxanes and Silicones, compounds  
RL: USES (Uses)  
(**polyoxyalkylene-polyurethane**-, block, graft, metal  
complexes, electrolytes, contg. anions, properties of, for  
**batteries**)
- IT **Urethane polymers**, compounds  
RL: USES (Uses)  
(**polyoxyalkylene-siloxane**-, block, graft, metal complexes,  
**electrolytes**, contg. anions, properties of, for  
**batteries**)
- IT **Polyoxyalkylenes**, compounds  
RL: USES (Uses)  
(**polyurethane-siloxane**-, block, graft, metal complexes,  
electrolytes, contg. anions, properties of, for **batteries**)
- IT **Batteries**, secondary  
(solid-electrolyte, **lithium, crosslinked** polyethers  
contg. **lithium** salt electrolytes for, properties of)
- IT **7439-93-2D, Lithium**, complexes with polyether-  
**polyurethanes** and block, graft polyether-**polyurethane**  
-siloxanes 7440-22-4D, Silver, complexes with polyether-  
**polyurethanes** and block, graft polyether-**polyurethane**  
-siloxanes 7440-23-5D, Sodium, complexes with polyether-  
**polyurethanes** and block, graft polyether-**polyurethane**  
-siloxanes  
RL: USES (Uses)  
(electrolytes, contg. anions, ion transport no. of, for  
**batteries**)
- IT 75-21-8D, Ethylene oxide, **polymers** with propylene oxide,  
Desmodur R, and di-Me siloxane, block, metal complexes 75-56-9D,  
Propylene oxide, **polymers** with ethylene oxide, Desmodur R, and  
di-Me siloxane, block, metal complexes 2422-91-5D, **polymers**  
with ethylene oxide, propylene oxide, and di-Me siloxane, block, graft,  
metal complexes 39394-47-3D, Desmodur R, **polymers** with  
ethylene oxide, propylene oxide, and di-Me siloxane, block, graft, metal  
complexes 116723-75-2D, metal complexes  
RL: USES (Uses)  
(**electrolytes**, contg. anions, properties of, salt concn. in  
relation to, for **batteries**)

- IT 75587-26-7D, metal complexes 75587-27-8D, Desmodur R-  
**polyethylene glycol** copolymer, metal complexes  
 RL: USES (Uses)  
 (electrolytes, contg. anions, sp. vol. of, salt concn. in relation to,  
 for **batteries**)
- IT 143-66-8, Sodium tetraphenylborate 2923-17-3, **Lithium**  
 trifluoroacetate 7601-89-0, Sodium perchlorate 7778-74-7, Potassium  
 perchlorate 7783-93-9, Silver perchlorate **7791-03-9**,  
**Lithium** perchlorate 10034-81-8, Magnesium perchlorate  
**33454-82-9**, **Lithium** trifluoromethane sulfonate  
 RL: USES (Uses)  
 (electrolytes, with polyether-**polyurethanes** and block, graft  
 polyether-**polyurethane**-siloxanes, for **batteries**)
- IT 75587-26-7 75587-27-8, Desmodur R-**polyethylene glycol**  
 copolymer  
 RL: PRP (Properties)  
 (sp. vol. of, **crosslinking** molality in relation to, for  
**battery** electrolytes)
- IT **7439-93-2D**, **Lithium**, complexes with polyether-  
**polyurethanes** and block, graft polyether-**polyurethane**  
 -siloxanes  
 RL: USES (Uses)  
 (electrolytes, contg. anions, ion transport no. of, for  
**batteries**)
- RN 7439-93-2 HCAPLUS  
 CN Lithium (7CI, 8CI, 9CI) (CA INDEX NAME)

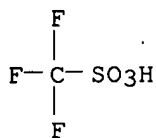
Li

- IT **7791-03-9**, **Lithium** perchlorate **33454-82-9**,  
**Lithium** trifluoromethane sulfonate  
 RL: USES (Uses)  
 (electrolytes, with polyether-**polyurethanes** and block, graft  
 polyether-**polyurethane**-siloxanes, for **batteries**)
- RN 7791-03-9 HCAPLUS  
 CN Perchloric acid, lithium salt (8CI, 9CI) (CA INDEX NAME)



Li

- RN 33454-82-9 HCAPLUS  
 CN Methanesulfonic acid, trifluoro-, lithium salt (8CI, 9CI) (CA INDEX NAME)



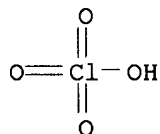
⊙ Li

- L21 ANSWER 43 OF 44 HCAPLUS COPYRIGHT 2003 ACS  
 AN 1987:580135 HCAPLUS  
 DN 107:180135  
 TI Mechanism of ionic conduction in polyether-**polyurethane** networks containing **lithium** perchlorate  
 AU Le Nest, J. F.; Defendini, F.; Gandini, A.; Cheradame, H.; Cohen-Addad, J. P.  
 CS Lab. Chim. Macromol. Papet., Ec. Fr. Papet., St. Martin d'Herès, 38402, Fr.  
 SO Journal of Power Sources (1987), 20(3-4), 339-44  
 CODEN: JPSODZ; ISSN: 0378-7753  
 DT Journal  
 LA English  
 CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
 Section cross-reference(s): 36  
 AB The swelling ratio of **polyethylene oxide-polyurethane** networks increased with the chain length in several org. liqs. without LiClO<sub>4</sub> and decreased when contg. the salt due to network-salt interactions involving the solvation of Li<sup>+</sup> ions by O atoms of the ether. Strong interactions take place between ionic quadrupoles and 2 polyether chains, leading to reversible physicochem. (ionic) **crosslinks**. The no. of the interactions grows with salt concn. up to a limit characterized by 1 ionic **crosslink** for every 12 ethylene oxide units. An ionic transport mechanism is given on the basis of this model for solid electrolytes in **Li batteries**.  
 ST **polyethylene oxide polyurethane lithium battery**; ionic transport electrolyte  
**lithium battery**; swelling **polyethylene oxide polyurethane** network  
 IT **Batteries**, secondary  
 (lithium, **polyoxyethylene-polyurethane** networks contg. **lithium** perchlorate electrolytes in)  
 IT Swelling, physical  
 (of **polyoxyethylene-polyurethane** networks contg. **lithium** perchlorate)  
 IT Electric conductivity and conduction  
 (ionic, of **polyoxyethylene-polyurethane** electrolytes contg. **lithium** perchlorate, for **lithium batteries**)  
 IT **Urethane polymers**, compounds  
 RL: USES (Uses)  
 (**polyoxyethylene-**, **lithium** complexes, ionic conduction in, for **lithium battery electrolytes**)

- IT 7439-93-2D, Lithium, polyoxyethylene-  
polyurethane complexes 80852-11-5D, lithium complexes  
RL: PRP (Properties)  
(ionic conduction in, for lithium battery  
electrolytes)
- IT 7791-03-9, Lithium perchlorate (LiClO<sub>4</sub>)  
RL: USES (Uses)  
(polymer networks contg., ionic conduction in, for  
lithium battery electrolytes)
- IT 56-23-5, Carbon tetrachloride, properties 67-66-3, Trichloromethane,  
properties 71-43-2, Benzene, properties 75-09-2, Methylene dichloride,  
properties 7732-18-5, Water, properties  
RL: PRP (Properties)  
(swelling of polyethylene-polyurethane networks in,  
lithium perchlorate addn. in relation to)
- IT 7439-93-2D, Lithium, polyoxyethylene-  
polyurethane complexes  
RL: PRP (Properties)  
(ionic conduction in, for lithium battery  
electrolytes)
- RN 7439-93-2 HCAPLUS  
CN Lithium (7CI, 8CI, 9CI) (CA INDEX NAME)

Li

- IT 7791-03-9, Lithium perchlorate (LiClO<sub>4</sub>)  
RL: USES (Uses)  
(polymer networks contg., ionic conduction in, for  
lithium battery electrolytes)
- RN 7791-03-9 HCAPLUS  
CN Perchloric acid, lithium salt (8CI, 9CI) (CA INDEX NAME)



Li

- L21 ANSWER 44 OF 44 HCAPLUS COPYRIGHT 2003 ACS  
AN 1985:439844 HCAPLUS  
DN 103:39844  
TI Poly(dimethylsiloxane)-poly(ethylene oxide) based polyurethane  
networks used as electrolytes in lithium electrochemical solid  
state batteries  
AU Bouridah, A.; Dalard, F.; Deroo, D.; Cheradame, H.; Le Nest, J. F.  
CS Lab. Energ. Electrochim., Domaine Univ., Saint Martin d'Herès, 38402, Fr.  
SO Solid State Ionics (1985), 15(3), 233-40  
CODEN: SSIOD3; ISSN: 0167-2738  
DT Journal

- LA English
- CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
Section cross-reference(s): 38, 76
- AB Ionic cond. and redox stability domain of a new type of **polymer electrolyte** were studied. The **polymer electrolytes** were prepd. from a network of poly(dimethylsiloxane-grafted ethylene oxide) copolymer (grafted PDMS) **crosslinked** by an aliph. **isocyanate** and contg. 10 wt.% LiClO<sub>4</sub>. Ionic conductivities  $>10^{-5}/\Omega\text{-cm}$  are obtained at 30.degree.. The study of the electrochem. stability of the **crosslinking** agent suggests that the unreacted **isocyanate** groups are not stable. The electroactivity domain of the grafted PDMS-10% LiClO<sub>4</sub> electrolyte is  $>3$  V. The performances of a solid-state **battery** using this electrolyte were investigated. The 1st discharge and charge depths were 73%. The rechargeability was compared with that of a **Li/RuO<sub>2</sub> battery** with a linear high mol.-wt. [poly(ethylene oxide)]<sub>8</sub>-LiClO<sub>4</sub> as electrolyte.
- ST **lithium battery** electrolyte **polyurethane**; dimethylsiloxane ethylene oxide graft copolymer; **isocyanate crosslinked** copolymer electrolyte; ruthenia **lithium** graft copolymer **battery**
- IT **Batteries**, secondary  
(**lithium-ruthenia**, with **lithium** perchlorate-contg. poly(dimethylsiloxane-grafted ethylene oxide) copolymer electrolyte, performance of)
- IT Electric conductivity and conduction  
(of poly(dimethylsiloxane-grafted ethylene oxide) **isocyanate-crosslinked** copolymer contg. **lithium** perchlorate)
- IT Siloxanes and Silicones, uses and miscellaneous  
RL: USES (Uses)  
(di-Me, copolymer of **polyethylene oxide**-, graft, **crosslinked** with aliph. **isocyanate**, electrolyte from **lithium** perchlorate-contg., **lithium battery**)
- IT 822-06-0 26471-62-5  
RL: MOA (Modifier or additive use); USES (Uses)  
(**crosslinking** agents, for dimethylsiloxane-**polyethylene oxide** copolymer)
- IT 25322-68-3D, **polymer** with dimethylsiloxane, **crosslinked** with aliph. **isocyanate**  
RL: USES (Uses)  
(graft, **electrolyte** from **lithium** perchlorate-contg., **lithium battery**)
- IT 822-06-0  
RL: MOA (Modifier or additive use); USES (Uses)  
(**crosslinking** agents, for dimethylsiloxane-**polyethylene oxide** copolymer)
- RN 822-06-0 HCAPLUS
- CN Hexane, 1,6-diisocyanato- (9CI) (CA INDEX NAME)

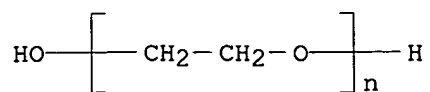
OCN- (CH<sub>2</sub>)<sub>6</sub>-NCO

- IT 25322-68-3D, **polymer** with dimethylsiloxane, **crosslinked** with aliph. **isocyanate**  
RL: USES (Uses)  
(graft, **electrolyte** from **lithium**

perchlorate-contg., lithium battery)

RN 25322-68-3 HCAPLUS

CN Poly(oxy-1,2-ethanediyl), .alpha.-hydro-.omega.-hydroxy- (9CI) (CA INDEX  
NAME)



# Ionic Conductivity and Physical Stability Study of Gel Network Polymer Electrolytes

ZHENGCHENG ZHANG, SHIBI FANG

Institute of Chemistry, Chinese Academy of Sciences, Beijing, 100080, People's Republic of China

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**ABSTRACT:** Gel polymer electrolytes (GPE) were prepared by a crosslinking reaction between poly(ethylene glycol) and a crosslinking agent with three isocyanate groups in the presence of propylene carbonate (PC) and ethylene carbonate (EC) or their mixture, and their ionic conducting behavior was carefully investigated. When the plasticizer amount was fixed, the ionic conductivity was greatly influenced by the nature of plasticizers. It was found that the conductivity data followed the Arrhenius equation in the GPE. Whatever plasticizer was used, a maximum ambient conductivity was found at a salt concentration near  $[Li^+]/[EO]$  equal to 0.20. The physical stability of GPE was studied qualitatively by weight loss of GPE under pressure. It was shown that the stability was greatly affected by the network structure of the GPE and the most stable one in our research was the GPE containing the PEO<sub>1000</sub> segment, which has a strong interaction between network and plasticizers. © 2000 John Wiley & Sons, Inc. *J Appl Polym Sci* 77: 2957–2962, 2000

**Key words:** gels; network polymer electrolytes; ionic conductivity; arrhenius equation; stability

## INTRODUCTION

Solid polymer electrolytes (SPE) have been quickly developed since the pioneering investigations were carried out by Wright et al.<sup>1</sup> and Armand et al.<sup>2</sup> in 1970s. Due to good mechanical strength, easy packaging, and high energy densities, applications of solid polymer electrolytes as separators for lithium batteries have been given a great deal of attention in recent years. For example, electric vehicles powered by solid-state batteries are becoming “new generation” traffic tools because of their ability to meet environmental requirement, so developing an appropriate polymer electrolyte is becoming an urgent task.

The widely investigated poly(ethylene oxide) (PEO)/alkali metal salt complexes exhibit very low ambient ionic conductivity, typically  $10^{-7}$   $\text{Scm}^{-1}$  because of the severe crystallinity of PEO. To hinder the crystallinity of PEO, various approaches such as copolymerization,<sup>3</sup> grafting,<sup>4</sup> and crosslinking<sup>5</sup> have been employed to prepare polymer hosts consisting mainly of amorphous PEO.

In our previous work,<sup>6</sup> network polymer electrolytes containing PEO chains were synthesized by a crosslinking reaction. Effects of various factors, such as crosslinking density and size of network on ionic conductivity of this system, were explored in detail. Although the resultant network polymer electrolytes were completely amorphous, as indicated by X-ray diffraction measurement, their ambient ionic conductivities were still rather low—only in the range of  $10^{-5}$   $\text{Scm}^{-1}$  or lower.

Correspondence to: S. Fang.  
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Therefore, the focus of our investigation has been turned to the gel polymer electrolytes (GPE). As is well known, gel polymer electrolytes, which are generally composed of polar polymer, alkali metal salts, and plasticizers, are a new generation of solid polymer electrolytes, and because of their high performance in the practical application to high-energy density lithium batteries, their preparation, electrical, and mechanical properties have been reported on in the last few years.<sup>7-9</sup> However, so far, little has been reported about the physical stability of this kind of electrolyte. This article will present the results on the physical stability as well as ionic conductivity of these gel polymer electrolytes.

## EXPERIMENTAL

### Materials

Poly(ethylene oxide) (PEO) with molecular weights of 600, 800, 1000, 1500, or 2000, lithium perchlorate ( $\text{LiClO}_4$ ), and plasticizers including ethylene carbonate (EC), propylene carbonate (PC), dimethyl formide (DMF),  $\gamma$ -butyrolactone ( $\gamma$ -BL), diethylene carbonate (DEC), and dimethyl ethyleneglycol (DME) were all purchased from Aldrich Chemical Company. PEO and  $\text{LiClO}_4$  were desiccated under vacuum at 120 and 170°C, respectively for 24 h prior to use. The plasticizers were distilled under vacuum and then stored with 4 Å molecular sieves. 1,1,1-Tri(hydroxy methyl) propane (TMP) was recrystallized using methanol, and toluene 2,4-diisocyanate (TDI) was used as received.

### Synthesis of the Crosslinking Agent of Gel Network Polymer Electrolytes

The detailed synthesis procedure of the crosslinking agent (TMP-TDI) was reported in our previous work.<sup>6</sup> Its reaction equation is shown in Figure 1.

### Preparation of Gel Network Polymer Electrolytes

PEO, TMP-TDI, and catalyst dibutyltin dilaurate (DBTDL),  $\text{LiClO}_4$  were mixed together with a plasticizer and anhydrous tetrahydrofuran (THF) (not used sometimes). Stirring vigorously, the mixture was heated to 80°C under nitrogen atmosphere and kept at this temperature for 1 h to form a viscous liquid, which was then cast in a

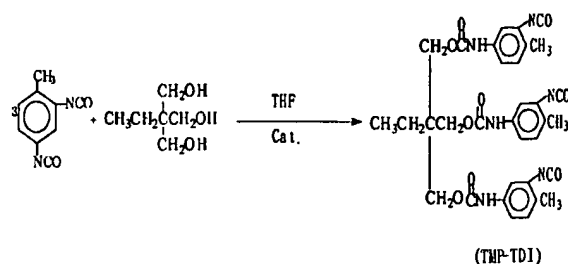


Figure 1 Synthesis of the crosslinking agent (TMP-TDI).

self-made polytetrafluoroethylene mold. After heating in the vacuum oven at 70°C for 48 h for curing, the final products were semitransparent films with good elasticity.

### Measurement

The ionic conductivity was measured using an HIOKI LCR 3520 Hi TESTER at 1 kHz. The experimental procedure was the following: a disk of known area was cut from the parent electrolytes film. The disk was placed in the center of a Teflon spacer ring and compressed between two stainless rods inserted into opposite ends of the Teflon spacer ring. The thickness of the samples was taken to be the Teflon spacer thickness for relatively thin and compressible samples, while the electrolyte thickness was measured with calipers for thicker and more rigid samples.

To estimate the gel fraction of the synthesized network polymers, weighed amounts of network polymers were extracted using tetrahydrofuran (THF) as the extracting solvent for 24 h on Soxhlet's extractors. After extraction, the gelled polymer was placed in a vacuum oven at 100°C for 24 h to get rid of the solvent, and the weight of the polymer was measured again. The gel fraction was calculated according to the following equation:

$$\text{Gel\%} = 100B/A$$

where  $A$  and  $B$  are weights of the network polymers before and after the extraction, respectively.

To study the physical stability of gel polymer electrolytes, a simple experiment was carried out on various systems. The samples were subjected to a fixed downward pressure (the weight of the downward object was fixed at 10 kg, and the areas of various samples were fixed at 4 cm<sup>2</sup>). For var-

**Table I** Gel Fraction of the Network Polymers Containing Various PEO Segments

Samples	PEO Molecular Weight ( $M_w$ )	Gel Fraction <sup>a</sup> (%)
NT-PEO <sub>600</sub>	600	98.3
NT-PEO <sub>1000</sub>	1000	97.5
NT-PEO <sub>1500</sub>	1500	95.6
NT-PEO <sub>2000</sub>	2000	94.0

<sup>a</sup> Tetrahydrofuran (THF) as the extracting solvent for 24 h on Soxhlet's extractor.

ious time intervals, the weight of each GPE sample were measured. The percent of weight loss is calculated according to the following equation:

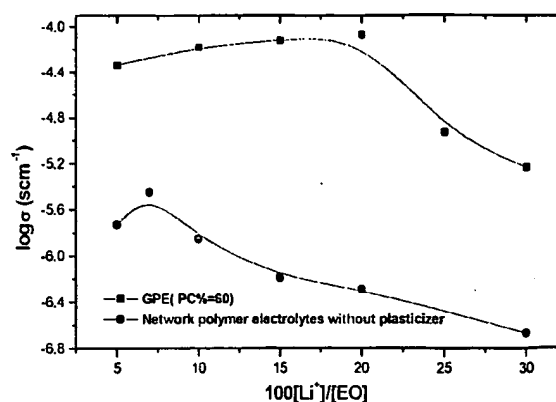
$$\text{Weight loss \%} = 100B/A$$

where  $A$  is the sample weight before exerted pressure,  $B$  is the sample weight after exerted pressure for different time intervals.

## RESULTS AND DISCUSSION

Table I lists the gel fraction of the network polymers containing various PEO segments. It can be seen from Table I that, with increasing of molecular weight of the PEO segment, the gel fraction is decreased proportionally from 98.3 to 94.0%. The results are relevant to the reactivity of poly(ethylene glycol) in the crosslinking reaction. The terminal hydroxy ( $\mu\text{OH}$ ) on the longer PEO<sub>2000</sub> segment is less active in the crosslinking reaction compared to that on the shorter PEO<sub>600</sub> segment. The 97.5% gel fraction of the network polymer containing the PEO<sub>1000</sub> segment is high enough to prepare gel network polymer electrolytes.

All gel polymer electrolytes showed a great enhancement of ambient conductivity compared to the electrolytes without plasticizers. Figure 2 offers a clear example of the above-mentioned difference. The ionic conductivity of GPE is nearly 2–3 orders of magnitude higher than that of the conventional electrolytes, as indicated in Figure 2, and the maximum conductivity of GPE appeared at  $[\text{Li}^+]/[\text{EO}]$  equal to 20%, which is much higher compared to the 10% of the conventional electrolytes. This phenomena is ascribed to the permittivity increasing of the whole GPE system, because the introduced PC plasticizer has a high

**Figure 2** Ambient ionic conductivity of GPE and the unplasticized network polymer electrolytes containing the PEO<sub>1000</sub> segment.

relative permittivity ( $\epsilon = 64.4$  at 25°C), which will contribute to the enhancement of the dissociation of ion pairs or ion clusters. At the same time, the apparent softer GPE films, relating to the plasticizing effect of PC, exhibit a much lower glass transition temperature ( $T_g = -60.2^\circ\text{C}$ ) than that of the unplasticized one ( $T_g = 23.7^\circ\text{C}$ ).

The effect of plasticizers on the polymer mobility and conductivity depends on the specific nature of the plasticizers, including viscosity, dielectric constants, polymer–plasticizer interaction, and ion–plasticizer coordination. Table II lists the ambient conductivity data of the GPE with various plasticizers.

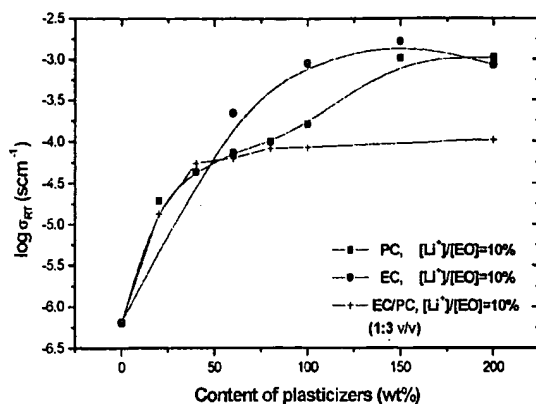
Ionic conductivity of GPE films containing PC, EC, and EC/PC mixed plasticizers, as a function

**Table II** Effect of Plasticizer on Ionic Conductivity of Gel Polymer Electrolytes<sup>a</sup>

Plasticizer <sup>b</sup>	$[\text{Li}^+]/[\text{EO}]$ (%)	Ambient Conductivity ( $\sigma$ , $\text{S cm}^{-1}$ )
no	10	$6.38 \times 10^{-7}$
DME	10	$9.70 \times 10^{-7}$
DEC	10	$1.14 \times 10^{-6}$
EC	10	$3.75 \times 10^{-5}$
EC/PC (1 : 3 v/v)	10	$5.48 \times 10^{-5}$
PC	10	$6.68 \times 10^{-5}$
EC/PC (3 : 1 v/v)	10	$4.25 \times 10^{-4}$
DMF	10	$3.71 \times 10^{-5}$
$\gamma$ -BL	10	$1.06 \times 10^{-4}$

<sup>a</sup> GPE containing the PEO<sub>1000</sub> segment;

<sup>b</sup> Weight of all kinds of plasticizers was fixed at 60%.

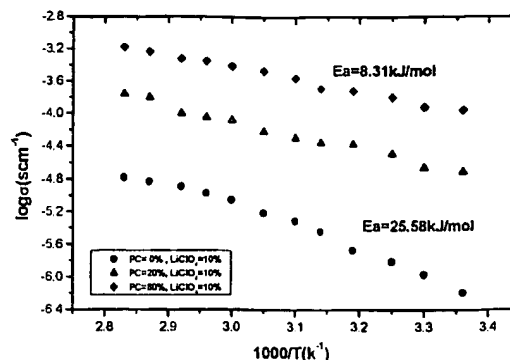


**Figure 3** Effect of the content of the plasticizers on room temperature conductivity for the GPE containing the PEO<sub>1000</sub> segment.

of the amount, is shown in Figure 3 for the series of the GPE system in which the PEO molecular weight is 1000. A maximum conductivity equal to  $1.1 \times 10^{-3} \text{ Scm}^{-1}$  at room temperature is observed in the GPE containing 200%(weight) PC plasticizer. No significant increase in the conductivity values are found when the amount of PC or EC/PC(1 : 3 v/v) plasticizer is increased from 20 to 100%; however, the conductivity for EC plasticized GPE showed substantial variation. For EC plasticized GPE, ionic conductivity was increased when EC increased from 50 to 150%. Above 150%, the conductivity dropped slightly, probably due to the tendency of EC to crystallize at room temperature. Although the dissolved EC was combined with the network skeleton intimately, and acted as an ionic conducting channel, at high enough levels, EC will crystallize, reducing ion migration.

The conductivity results for GPE with mixed plasticizers are also shown in Figure 3. The mixture of plasticizers was chosen with the ratio EC/PC = 1 : 3, where the EC/PC ratio refers to the volume ratio of the plasticizers EC and PC. With a 1 : 3 mixture of plasticizers EC and PC, the GPE shows conductivity values lower than those for samples with pure PC or pure EC at all temperatures studied.<sup>7</sup>

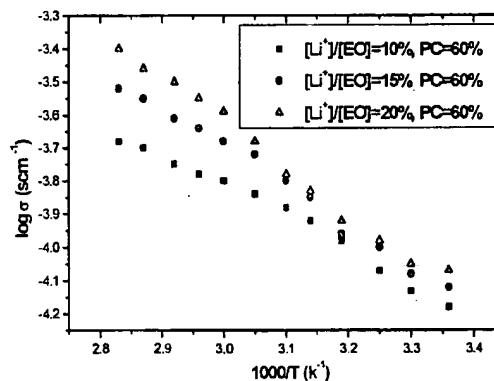
Arrhenius plots for GPE and unplasticized network polymer electrolytes are depicted in Figure 4 for different plasticizer levels, and in Figure 5 for different salt levels. As shown in Figure 4, the Arrhenius plots of all the plasticized electrolytes are almost linear, which is different from the curved line of the unplasticized network polymer



**Figure 4** Arrhenius plots for the GPEs with the PC plasticizer.

electrolytes. The calculated activation energy for the investigated PC plasticized GPE is 8.31 kJ/mol, which is much lower than that of the unplasticized network polymer electrolytes (25.58 kJ/mol, calculated from the VTF equation). Ion migration in the network polymer electrolytes follows the VTF equation, and is probably due to the segmental movement of the polymer. In the GPEs, the network polymer matrix offers little contribution to ion conduction, and the plasticizers act as the main channel for ion migration.

A different effect of temperature on ionic conductivity is shown in Figure 5. In the low temperature range, the ionic conductivities of the three GPEs with different LiClO<sub>4</sub> concentrations exhibit no significant difference, but at higher temperatures, the difference is extremely large. One interpretation is that the dissociation of LiClO<sub>4</sub> becomes easier with increasing temperature.



**Figure 5** Effect of temperature on the GPE containing the PEO<sub>1000</sub> segment.

Successful gel polymer electrolytes call for both dimensional stability and ambient high ionic conductivity. The leakage of plasticizers from the polymer matrix will result in an unstable electrolytes/electrode interface caused by the reaction with the active electrode. A simple experiment was carried out to investigate this aspect on our synthesized GPEs. The subject GPE had the same plasticizer PC, where the amount was fixed at 200% of the network polymer host. The results are depicted in Figure 6.

The weight loss directly relates to the interaction between the network polymer and the plasticizers. This interaction alters with the plasticizer nature and the network structure. When the plasticizer and its amount are fixed, the interaction will be influenced only by the network structure. After a fixed pressure for 1 day, the weight loss percent of GPEs with different structures was identical, about 2% (weight). Five days later, the GPE containing the PEO<sub>1500</sub> segments had a relatively higher weight loss compared to that of the GPEs containing the PEO<sub>1000</sub> and PEO<sub>600</sub> segments. After 12 days or longer, the weight loss of any GPEs was not altered, and kept the same order: GPE(PEO<sub>1500</sub>) > GPE(PEO<sub>600</sub>) > GPE(PEO<sub>1000</sub>).

It is clear that the GPE containing PEO<sub>1000</sub> is the best candidate electrolyte due to its good dimensional stability. Too large or too small a network size is detrimental to the dimensional stability of GPE. So we made a further investigation on the ambient conductivity of GPE containing the PEO<sub>1000</sub> segment. Figure 7 is the relationship between the plasticizer weight loss and the ambient ionic conductivity. It can be observed from

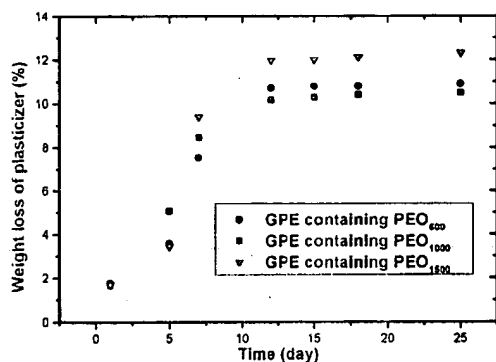


Figure 6 Weight loss of different GPEs with the same plasticizer content (200%) as a function of time.

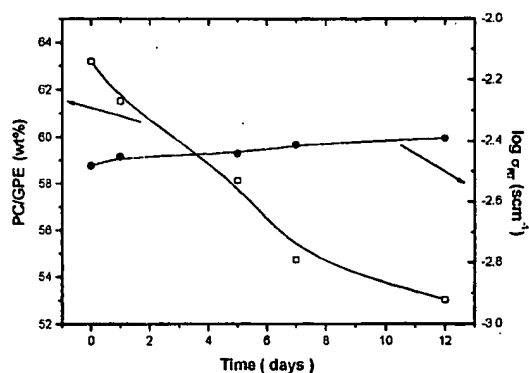


Figure 7 Relationship between weight loss and ambient conductivity for GPEs containing the PEO<sub>1000</sub> segment.

Figure 7 that although the PC content is decreased from 63.7 to 53.7% after 12 days, the GPE has no significant deterioration in ambient ionic conductivity, which is consistent with the results obtained from Figure 3.

## CONCLUSIONS

The gel network polymer electrolytes exhibit ambient conductivities of nearly three orders of magnitude higher than those of unplasticized electrolytes. The effect of LiClO<sub>4</sub> concentration on ionic conductivity is slightly different from the conventional one, except for the appearance of a maximum ionic conductivity. Different plasticizers will affect ionic conductivity due to different variability in characteristics such as permittivity and viscosity. The GPEs investigated in our study followed the Arrhenius plots, not the VTF type, which indicated that ionic migration in the GPE mainly takes place in channels existing in the plasticizers. GPEs with different network structure have different physical stability, among which the GPE containing the PEO<sub>1000</sub> segment gave the best stability after a long time pressure, mainly due to the stronger interaction between the plasticizer and the networks. In the GPE containing the PEO<sub>1000</sub> segment, the ambient conductivity showed no significant alteration when the plasticizers escaped from the networks under pressure.

We are indebted to Professor Youhuai Wang and Yongjun Li for their valuable suggestions. This re-

search is financed by the "863" Research Project of People's Republic of China.

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# Crosslink d Polyethers as Media for Ionic Conduction

Jean-François Le Nest, Alessandro Gandini\* and Hervé Cheradame

Laboratoire de Chimie Macromoléculaire et Papetière, Ecole Française de Papeterie (INP-G),  
BP 65, 38402 Saint Martin d'Hères Cedex, France

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**Abstract:** A broad outline is given of a comprehensive investigation dealing with solid polymeric electrolytes containing ionic species. These materials are based on various types of polyethers (homopolymers, block and graft copolymers) crosslinked via urethane chemistry and either filled with a salt or transformed into ionomers with the anions attached to the chains. The properties studied were specific volume, swelling, glass transition temperature, viscoelasticity, ionic conductivity, transport numbers, magnetic relaxation of nuclei from both the polymer chains and the ions, and redox stability. Mechanisms and models are proposed to explain chain partitioning by cations and the mode of ionic transport. An all-solid-state battery was prepared with one of these materials to prove its good performance.

**Key words:** Polyether networks, ionomeric networks, ionic conductivity, glass transition temperature, swelling, nuclear magnetic relaxation, viscoelasticity, transport number, solid polymer electrolyte, redox stability, batteries.

## 1 INTRODUCTION

The use of macromolecular materials as electrolytes for solid-state batteries was first envisaged over a decade ago.<sup>1,2</sup> The underlying features sought for these polymers were good solvating power *vis-à-vis* the cations (which of course implies a reasonable solubility of the salt in the macromolecular matrix), an essentially cationic charge transport leading to conductivities as high as possible, and an adequate electrochemical stability. Linear polyethers were initially studied and conductivities of about  $10^{-5} \text{ S cm}^{-1}$  obtained at room temperature with various salts.<sup>2</sup>

Since then, many laboratories have been tackling these problems with different materials and working hypotheses.<sup>3</sup> Three major drawbacks were soon encountered: (i) crystallization of part of the polymer (high DP) which relegates ionic mobility to the amorphous regions;<sup>4</sup> (ii) lack of dimensional stability due to creep, particularly at higher temperatures; (iii) cationic transport numbers much lower than unity.<sup>5</sup>

\* To whom correspondence should be addressed.

The approach chosen in our laboratory<sup>6-21</sup> called upon the basic premise that crosslinking the polyether chains would minimize crystallization and eliminate creep. As for a solution to the third problem, ionomeric networks with anions fixed on the chains were envisaged. This paper presents a panoramic view of the different sets of results obtained with networks containing either a dissolved salt or an attached ionizable moiety. From this wide investigation which began at the end of the last decade, conclusions will be proposed concerning molecular-scale models of ion-chain interactions, the origin and mode of ionic transport and the electrochemical performance of some of these systems.

## 2 EXPERIMENTAL

### 2.1 Network preparation

Most of the networks were based on the use of multifunctional isocyanates as crosslink agents reacting with polyether chains through their terminal or pendant hydroxyl groups. However, other

TABLE 1. Network precursors

## (a) Polyether-ols

Polyol, formula (abbreviation)	Source	$M_n$	$F_n^a$	$M_w/M_n$
Poly(ethylene oxide) $\alpha,\omega$ -diol (PEO) $HO-(CH_2CH_2O)_nH$	Merck	220 420 620 1 050 1 550 2 100 3 200 3 800 6 000 10 000	2.07 2.04 2.03 2.03-2.04 2.02 2.05-2.05 2.05 2.07 2.08 2.06	1.03 1.03 1.03 1.05 1.05 1.06 1.04
Poly(propylene oxide) $\alpha,\omega$ -diol (PPO) $HO-(CH(CH_3)CH_2O)_nH$	Aldrich	1 030 2 020	2.01 2.01	1.03
Tris(poly(propylene oxide)- $\omega$ -ol) glycidyl ether $CH_2-O-(CH_2CH(OCH_2CH_2O)_3H$ $ $ $CH-O-(CH_2CH(OCH_2CH_2O)_3H$ $ $ $CH_2-O-(CH_2CH(OCH_2CH_2O)_3H$	Lankro	1 490	3.00	
Triblock copolymers $\alpha,\omega$ -diol (PEO-b-PPO-b-PEO) (a) $HO(C_2H_4O)_{45}(C_3H_6O)_{17}(C_2H_4O)_{45}H$ (Pluronic F 38) (b) $HO(C_2H_4O)_{78}(C_3H_6O)_{26}(C_2H_4O)_{78}H$ (Pluronic F 68)	BASF Wyandotte and Ugine Kuhlmann	4 980 8 390	2.03 2.04	
Graft-block copolymers polydimethylsiloxane-g-polyether-(b) PDMS-g-(PPO-b-PEO OH) $(CH_3)_3Si-(OSi(CH_3)_2)_n-(OSi(CH_3)_2)_mOSi(CH_3)_3$ $ $ $CH_3$ $R$ $(R = -CH_2CH_2CH_2(OC_2H_5)_{10}-(OC_2H_4)_{12}OH)$	Rhône-Poulenc	19 400	14	

<sup>a</sup> Average functionality (OH) as determined by acetylation or <sup>1</sup>H n.m.r. ("")

## (b) Multifunctional isocyanates

Compound, formula (abbreviation)	Source	Molar mass
Hexamethylene diisocyanate OCN(CH <sub>2</sub> ) <sub>6</sub> NCO (HMDI)	Merck	168
Toluene 2,4-diisocyanate CH <sub>3</sub> C <sub>6</sub> H <sub>3</sub> (NCO) <sub>2</sub> (TDI)	Fluka	174
4,4',4''-Methylidine tris(phenylisocyanate) HC(C <sub>6</sub> H <sub>4</sub> NCO) <sub>3</sub> (Desmodur R)	Bayer	367
OCN(CH <sub>2</sub> ) <sub>6</sub> N(CONH(CH <sub>2</sub> ) <sub>6</sub> NCO) <sub>2</sub> (Desmodur N)	Bayer	478



# Crosslinked polyethers as media for ionic conduction

255

methods of reticulation were also tested, namely the reaction of polyether OH end-groups with  $\text{POCl}_3$  and  $\text{PSCl}_3$ , with  $\text{Ti}(\text{OR})_4$  or  $\text{AlEt}_3$ ; the preparation and polymerization of difunctional acrylic and vinylic polyether macromers;<sup>22</sup> the  $\gamma$ -ray irradiation of linear high-DP polyethers; and the interaction between tetramethyltetrahydrosiloxane (D4H) and diallyl polyethers.<sup>23</sup> The urethane technique of crosslinking gave the most reliable materials and was therefore given preference. Thus, the largest part of the work described here relates to these networks which were structurally more uniform and well-defined than most others. An indication of their quality is illustrated by the fact that extractions with different solvents gave soluble material amounting to less than 0.5%. Investigation of the properties of the other networks was limited to a set of comparative tests and only in the specific instance of siloxane-based polyether networks does it seem likely that one could get good control over the crosslinking process, and a behaviour and performances as interesting as with the urethane-based counterparts.

**2.1.1 Networks with added salts.** Neutral networks possessing a wide variety of structures were synthesized from carefully dried nearly monodisperse polyether glycols, triols or polyols and di- or triisocyanates.<sup>24</sup> Table 1 lists these starting materials and their properties, and shows the scope of this work in terms of variety of structures and chain lengths explored. This includes classical variables such as the DP of the polyether precursor, the type of unit in these oligomers and the structure of the isocyanates, and also more elaborate situations like the use of block and graft copolymers as the polyether precursor. In some specific instances, another variable was carefully controlled, namely the concentrations during synthesis, to allow a study of the swelling behaviour of the networks as discussed below. To all these networks different anhydrous salts were added, either directly before the crosslinking operation or into the final reticulate by

diffusion. The range of salts investigated is shown in Table 2.

The actual crosslinking procedure consisted of carrying out the (catalysed) reaction between the components added in stoichiometric amounts ( $\text{OH}/\text{NCO} = 1$ ) inside a flat mould made of silylated glass. This afforded a regular sheet of material without bubbles and with constant thickness. Details of these syntheses have been reported elsewhere.<sup>8</sup> These membranes were stored in an inert atmosphere and cut and transferred to the specific measuring device without exposure to moisture.

**2.1.2 Ionomeric networks.** Different techniques were used to attach anionic moieties covalently to the network chains. The first involved preparing polyether-urethane networks bearing phosphate or thiophosphate anions. It implied an initial reaction between  $\text{POCl}_3$  or  $\text{PSCl}_3$  and excess polyether glycol (typically two glycol molecules per phosphorus reagent) so as to obtain short chains with OH end-groups and  $\text{OP}-\text{Cl}$  groups which were then transformed into  $\text{OP}-\text{O}^-\text{Mt}^+$ . Crosslinking took place with triisocyanates according to the procedure described above for neutral networks. Details of the preparations of a variety of such ionomeric materials have been given elsewhere.<sup>25</sup>

The second approach called upon the use of a polyether polyol on which a fraction of the OH groups were transformed into alkali metal alcoholates. Then a Lewis acid was added to this polymer in order to enhance the dissociation of the ionizable group, e.g.  $-\text{OLi} + \text{SbCl}_5 \rightarrow -\text{O}(\text{SbCl}_5)^- + \text{Li}^+$ . These ionomers were finally crosslinked by the reaction of specific multifunctional isocyanates with the remaining OH groups left on the polyether chains. The specific features of these operations have been described.<sup>26</sup>

Finally, a third technique was adopted. It consisted of treating a polyether polyol with a reagent containing an ionized group and an acid chloride moiety, e.g.  $\text{ClOC}-(\text{CF}_2)_3\text{COO}^-\text{Li}^+$ , to obtain the corresponding ester-type ionomer. Crosslinking with isocyanates concluded the operation.<sup>26</sup>

TABLE 2. Metal salts tested

Formula	Source	Molar mass
$\text{LiClO}_4$	G. Frederick Smith	106.4
$\text{LiCF}_3\text{SO}_3$		156.0
$\text{LiBF}_4$	Ventron	93.8
$\text{LiCF}_3\text{CO}_2$	Ventron	120.0
$\text{LiSCN}$	Fluka	65.0
$\text{NaClO}_4$	Riedel-de-Haën	122.4
$\text{KClO}_4$		138.6
$\text{Mg}(\text{ClO}_4)_2$	Merck	223.2
$\text{NaB}(\text{C}_6\text{H}_5)_4$	Merck	342.2

## 2.2 Network properties

**2.2.1 Specific volume.** The specific volumes of the various materials were determined by pycnometry with mercury.

**2.2.2 Glass transition temperature.**  $T_g$  values of these materials were obtained by differential scanning calorimetry (d.s.c.) with a Dupont 990 instrument. Given the propensity of some networks to display local crystallization phenomena, all samples were heated at 100°C and quenched in liquid nitrogen before analysis.

**2.2.3 Swelling.** The amount of liquid intake by a given system was determined gravimetrically after equilibrium had been reached.

**2.2.4 Dynamic mechanical properties.** The viscoelastic behaviour of the materials was studied at different frequencies and temperatures on a Rheovibron DDV-II analyser.

**2.2.5 Ionic conductivity.** The complex-impedance method was applied<sup>10</sup> using a Solartron 1174 instrument.

**2.2.6 Transport numbers.** As already published,<sup>13</sup> the choice of technique for the determination of this parameter rested on Tubandt's method.

**2.2.7 Nuclear magnetic relaxation.** The behaviour of  $^1\text{H}$ ,  $^7\text{Li}$ ,  $^{11}\text{B}$ ,  $^{19}\text{F}$  and  $^{31}\text{P}$  nuclei was analysed with a Bruker WP100 FT spectrometer.

### 3 RESULTS AND DISCUSSION

#### 3.1 Specific volume

The variation of the specific volume of polyether networks was studied in two well-defined contexts.

**3.1.1 Saltless networks.** The relevant variable in saltless networks is the crosslink density for a given type of polyether, the influence of the nature of the isocyanate used to prepare the network being negligible. Figure 1 shows the linear dependence of  $\bar{V}$  for poly(ethylene oxide), PEO, at 22°C, on the crosslink molality  $m$  (which was varied by using PEO glycols of different DP). From these results, the simple relationship (1) is obtained:

$$\bar{V} = \bar{V}_0 - 0.11m \quad (1)$$

where  $\bar{V}_0$  is the specific volume extrapolated linearly to  $m=0$  (Fig. 1). This parameter represents the specific volume of a linear amorphous PEO of very high DP. The fact that the experimental points at very low  $m$  deviate from the extrapolated linear plot is due to the important contribution of crystalline regions arising from the ease with which long PEO chains can form organized domains. Equation (1) can be further developed taking into account the contribution of the urethane links to the changes in specific volume. This more precise approach has been given elsewhere.<sup>18,24</sup>

**3.1.2 Salt-containing networks.** Two sets of measurements were carried out, using in each case fixed network structures and segmental sizes and varying the molality  $m'$  of the added salt,  $\text{LiClO}_4$ . The first

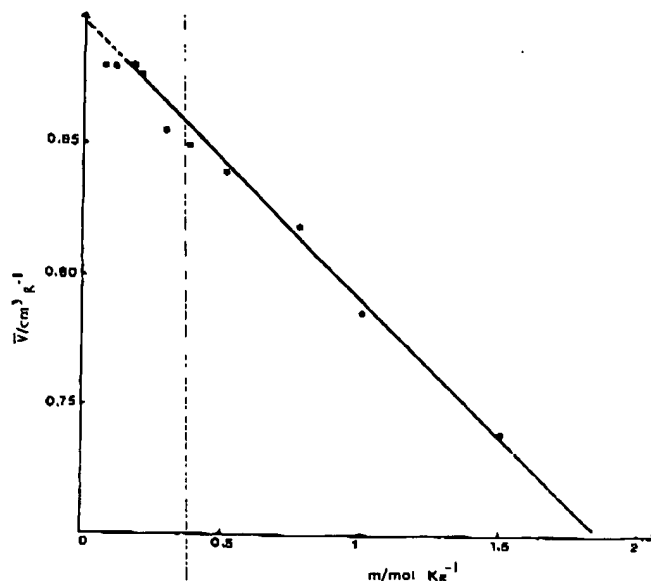


Fig. 1. Dependence of the specific volume on crosslinking molality, for a series of networks prepared with PEO glycols of different DP and Desmodur R triisocyanate (see Table 1).

involved a PEO glycol of  $M_n = 1050$ , the second a PEO glycol of  $M_n = 2100$ . Figure 2 shows the results obtained with both systems. The two straight lines are parallel and the equation describing them is

$$\bar{V} = \bar{V}_0' - 0.051m' \quad (2)$$

where  $\bar{V}_0'$  is the specific volume of the corresponding saltless network. If one were to assume that volume additivity could be applied to these situations, it would follow that

$$\bar{V} = \bar{V}_0' - 0.046m' \quad (3)$$

as shown by the dotted line in Fig. 2. The coefficient 0.046 was calculated from the specific values of PEO 1050-based network and of  $\text{LiClO}_4$ . For systems involving PEO 2100 its value was 0.047. The experimental results indicate, however, that when the salt is dissolved in these networks a relative contraction  $-\Delta\bar{V}$  takes place with respect to linear volume additivity, such that

$$-\Delta\bar{V} = 0.005m' \quad (4)$$

This phenomenon is probably due to complexation between the lithium cation and the electron doublet on the ether oxygen atoms of the PEO chains. In other words,  $\text{Li}^+$  ions introduce ion-dipole crosslinks by interacting with the network chains. A comparison of this effect (Fig. 2) with the extent of contraction produced by an increase in crosslink density (Fig. 1) shows that the latter phenomenon produces a much more drastic reduction of the free volume of the network than does the former.<sup>18,24</sup> The reason for the departure of the upper curve of Fig. 2 from linearity is not clear at present.

## Crosslinked polyethers as media for ionic conduction

257

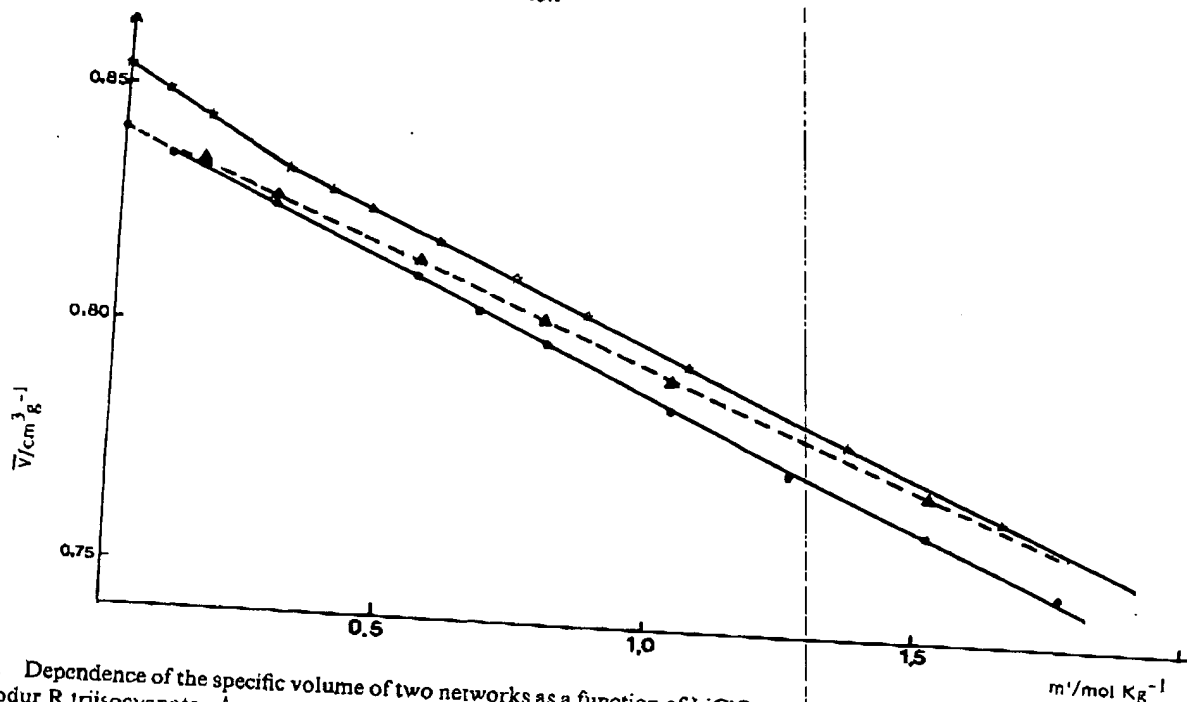


Fig. 2. Dependence of the specific volume of two networks as a function of  $\text{LiClO}_4$  molarity  $m'$ .  $\bullet$ , networks based on PEO 1050 and Desmodur R triisocyanate;  $\times$ , networks based on PEO 2100 and Desmodur R triisocyanate;  $\Delta$ , calculated behaviour in the case of specific volume additivity between salt and network.

### 3.2 Glass transition temperature

The networks investigated were the same as in the preceding section.

**3.2.1 Saltless networks.** Figure 3 shows that a linear relationship holds between  $T_g^{-1}$  and the crosslink molarity  $c$ :

$$T_g^{-1} = T_{g0}^{-1} - 7.6 \times 10^{-4} c \quad (5)$$

where  $T_{g0}$  is the glass transition temperature obtained by extrapolating the straight line in Fig. 3 to  $c = 0$ . If one rewrites eqn (5) introducing the relative variation of  $T_g$ , and inserting the value  $T_{g0} = 209 \text{ K}$  one obtains:

$$\frac{T_g - T_{g0}}{T_{g0}} = \frac{0.16c}{1 - 0.16c} \quad (6)$$

which has the same form as a Di Marzio's classical relationship:<sup>27</sup>

$$\frac{T_g - T_{g0}}{T_{g0}} = \frac{ac}{1 - ac} \quad (7)$$

**3.2.2 Salt-containing networks.** Three distinct networks were used to study the effect of  $\text{LiClO}_4$  concentration on the glass transition temperature. Figure 4 illustrates again the linear dependency of  $T_g^{-1}$  on the molar concentration  $c'$  of the salt. Interestingly the slope of these lines is independent

of the length of the PEO segments between urethane crosslinks:

$$T_g^{-1} = T_{g0}^{-1} - 2.7 \times 10^{-4} c' \quad (8)$$

where  $T_{g0}$  is the glass transition temperature of each corresponding saltless network. It is worth mentioning that the same slope was found when using different triisocyanates<sup>18,24</sup> and  $\text{D4H}^{23}$  as crosslink agents. On the other hand, replacing the PEO chains with PEO-PPO blocks (Table 1) induces an apparent increase in the slope, the linearity being, however, respected. It can be shown<sup>24</sup> that the complexation of  $\text{Li}^+$  is much more favoured for the PEO segments and that by using a recalculated concentration based on this fact, a slope close to  $2.7 \times 10^{-4} \text{ dm}^3 \text{ mol}^{-1} \text{ K}^{-1}$  is again obtained.<sup>24</sup>

Finally, if a PDMS-g(PEO-b-PPO) polyol (Table 1) is used to construct the networks, the partition of lithium cations is even more selective in that the silicone trunk chains do *not* solvate these cations at all, which therefore complex again, mostly with the PEO segments. The silicone chains however, play an important role in substantially lowering the glass transition temperature.<sup>14,24</sup> The concept of ion-dipole crosslinking arising from the complexation of a lithium cation with two PEO chains applies here in a more explicit fashion than with the results concerning specific volume. Comparison of Figs. 3 and 4 indicates that (i) increasing either the crosslink density or the salt concentration induces an increase in  $T_g$  and (ii) the effect of the former is more

Jean-François Le Nest, Alessandro Gandini, Hervé Cheradame

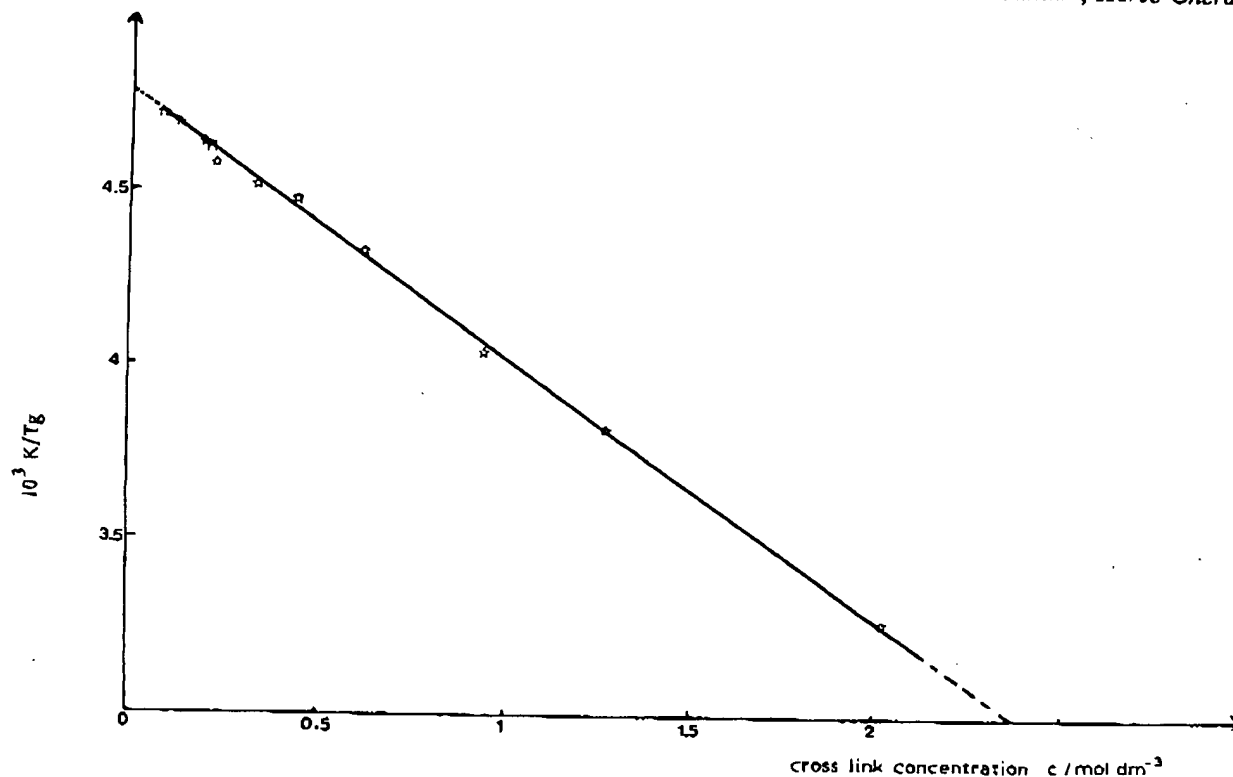


Fig. 3. Dependence of the inverse of  $T_g$  on crosslinking molarity  $c$ , for a series of networks based on PEO glycols of different DP and Desmodur R triisocyanate.

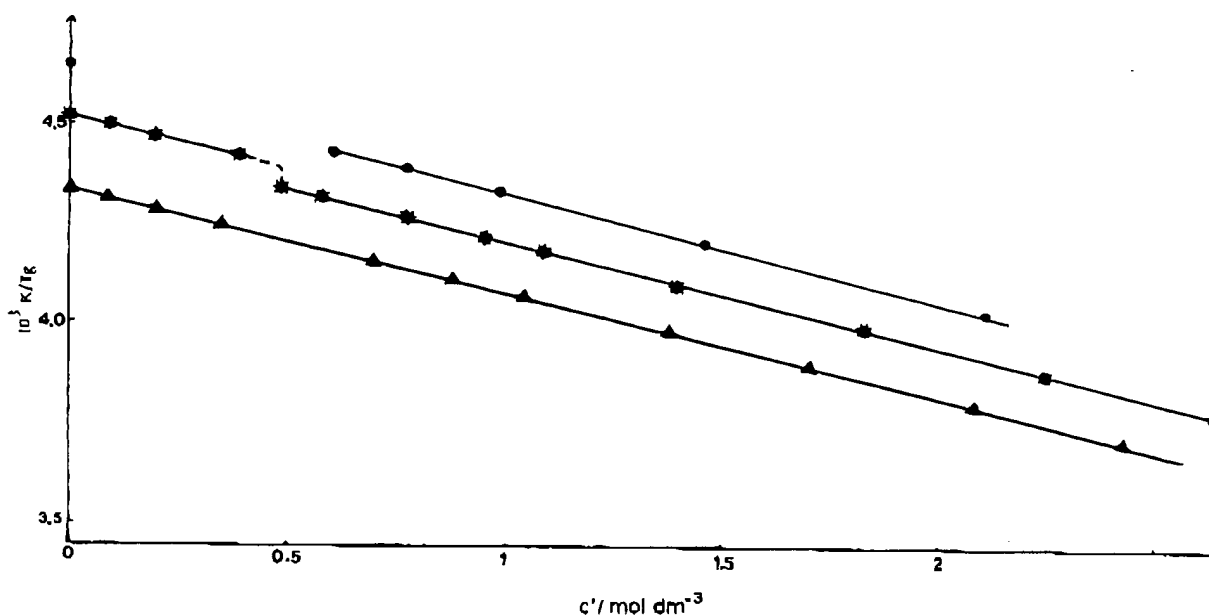


Fig. 4. Dependence of the inverse of  $T_g$  as a function of  $\text{LiClO}_4$  molarity  $c'$ .  $\blacktriangle$ , Networks based on PEO 1050 and Desmodur R triisocyanate;  $\star$ , networks based on PEO 2100 and Desmodur R triisocyanate;  $\bullet$ , networks based on PEO 3800 and Desmodur R triisocyanate.

### Crosslinked polyethers as media for ionic conduction

259

important than that of the latter by a factor of about 3 (ratio of the slopes). As a consequence, these systems can be described within a single general framework which allows the prediction of the glass transition temperature for any network involving PEO and  $\text{LiClO}_4$  through an appropriate abacus.<sup>24</sup>

### 3.3 Swelling properties

The behaviour of the networks discussed in the previous sections (with and without added salts) towards swelling in various types of liquids has already been partly reported.<sup>19,21</sup> Whereas with relatively polar liquids the decrease of the swelling ratio  $q$  (v/v) with increasing salt concentration followed a linear trend, the same plots with non-polar liquids gave a marked non-linear decrease followed by a tailing off at high  $\text{LiClO}_4$  concentrations. The trend observed with saltless

networks as a function of the crosslink concentration was the same as that described above with non-polar liquids.<sup>19,21</sup> Assuming again that the lithium cations play the role of crosslink agents, it was possible to show that the behaviour of these systems in non-polar solvents could be rationalized quantitatively with and without added salt: it was found that one ionic (complexation) crosslink afforded the same effect as one urethane crosslink.<sup>19,21</sup> On the contrary, with polar solvents, the ionic interactions with the PEO chains are loosened and as a consequence, the effect of salt concentration on  $q$  considerably reduced.

The three types of measurements described thus far in this overall investigation have provided complementary evidence to show that the introduction of a metal salt into a polyether-type matrix brings about reversible dynamic crosslinking due to ion-dipole binding of chain segments induced by the ionic species.

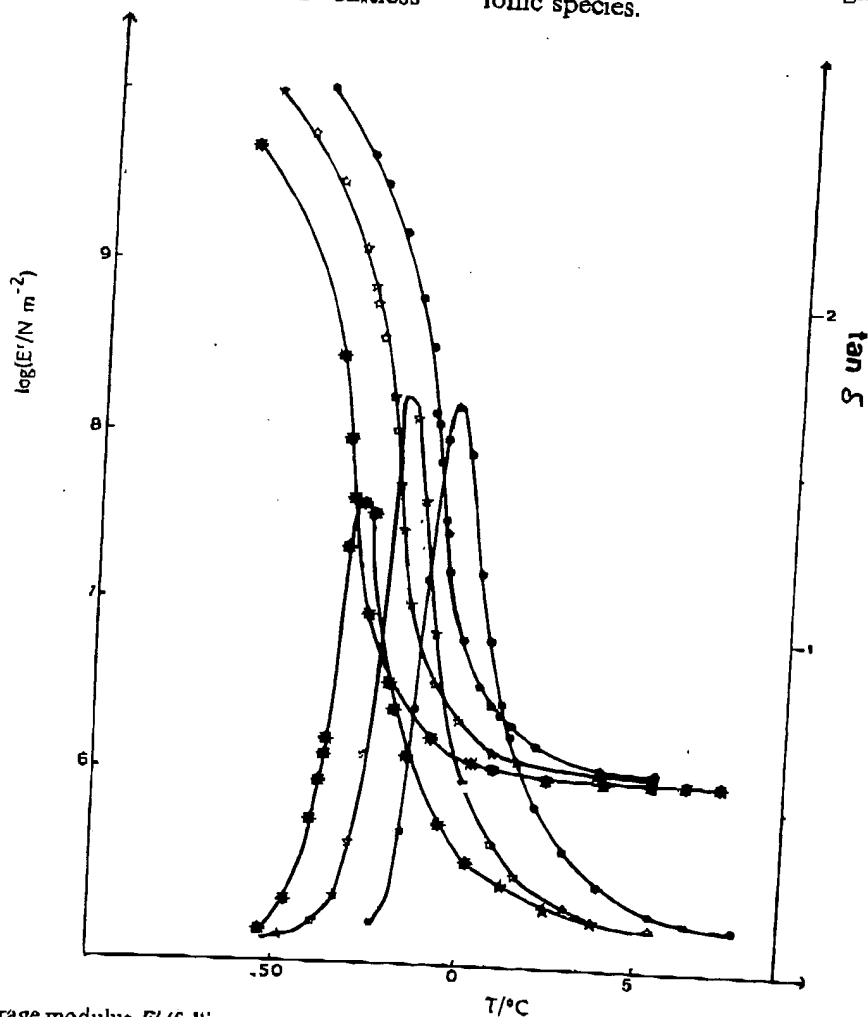


Fig. 5. Variations of storage modulus  $E'$  (falling curves) and loss tangent  $\tan \delta$  (curves with maxima) as a function of temperature at 11 Hz for a network prepared from PEO-b-PPO-b-PEO ( $M_n = 4980$ , see Table I) and Desmodur R triisocyanate, and containing  $\text{LiClO}_4$ : ★, 12% w/w; ☆, 16% w/w; ●, 23% w/w.

### 3.4 Dynamic mechanical properties

Previous studies in this laboratory on the viscoelastic behaviour of networks based on PEO or PPO and containing various salts<sup>6,9,18</sup> led to the establishment of master curves (WLF) correlating as usual the storage modulus with frequency and temperature but also with a novel parameter, i.e. the salt concentration. This investigation has now been extended to new networks based on PEO-b-PPO-b-PEO glycols and PDMS-g(PPO-b-PEO) polyols (Table 1) crosslinked with various di- and triisocyanates and filled with different concentrations of lithium perchlorate. Figures 5, 6 and 7 provide an example of the dynamic chemical properties on one such type of network based on polyether block copolymers. As in previous studies, the classical WLF features were clearly observed (Fig. 6), including the superposition with respect to salt concentration (Fig. 7). Table 3 gives the  $C_1$  and  $C_2$  values at  $T_g$  for these networks. With PDMS-based systems the results were entirely similar.

### 3.5 Ionic conductivity

It has already been shown<sup>6,10,14,15,18</sup> that the transport of ions across polyether-based networks

TABLE 3. WLF constants<sup>a</sup> for the networks characterized in Figs 5–7, with  $T_g$  as reference temperature

Salt conc. (% w/w)	$C_1$	$C_2$ (K)	$T_g$ (K)
12	10.5	48	240
16	10.4	51	248
23	10.1	50	265

$$^a \log_{10} a_T = -\frac{C_1(T - T_g)}{C_2 + T - T_g}$$

follows a free-volume law, i.e. WLF behaviour. However, this was carried out with a limited number of systems and only recently further studies have considerably expanded the scope of this investigation. In particular, it was shown that the  $C_1$  and  $C_2$  values obtained from a WLF treatment of the conductivity-vs-temperature data<sup>18,28</sup> were all very similar ( $C_1 = 10 \pm 2$  and  $C_2 = 50 \pm 5$  K) for a large number of materials. More specifically the two constants were found to be independent of (i) the nature of the crosslinking agent, viz. the structure of the triisocyanate used<sup>18,28</sup> and D4H;<sup>23</sup> (ii) the length of the polyether glycol precursor; (iii) the nature of the polyether (structure, homopolymer, block or graft copolymer, cf. Table 1); (iv) the alkali metal ion

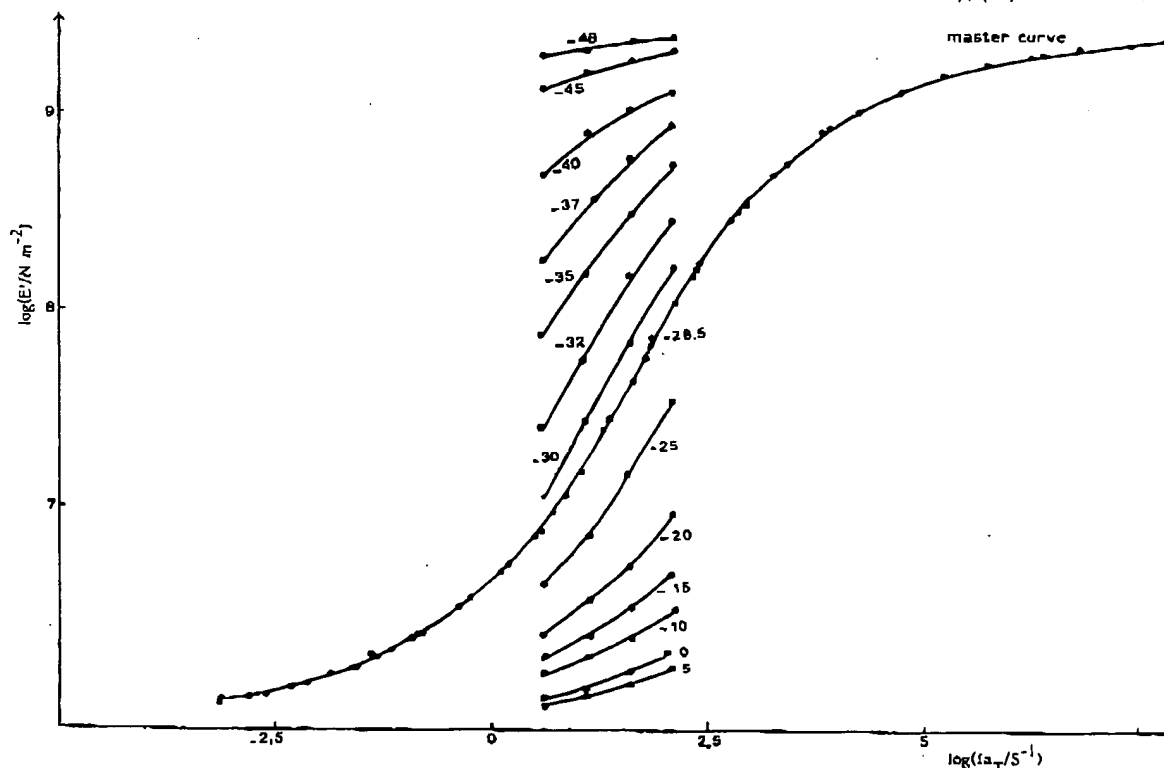


Fig. 6. A typical master curve constructed from data referring to the network containing 12%  $\text{LiClO}_4$  [(w/w), cf. Fig. 5] using a reference temperature of  $-28.5^\circ\text{C}$ . The central parts of the curves, with appropriate temperatures in  $^\circ\text{C}$  from which the master curve is constructed, are also shown.  $fa_T$  is the product of the excitation frequency ( $\text{s}^{-1}$ ) and the shift factor defined as the ratio of the relaxation times at  $T$  and  $T_g$  respectively, viz.  $a_T = \tau(T)/\tau(T_g)$ .

## Crosslinked polyethers as media for ionic conduction

261

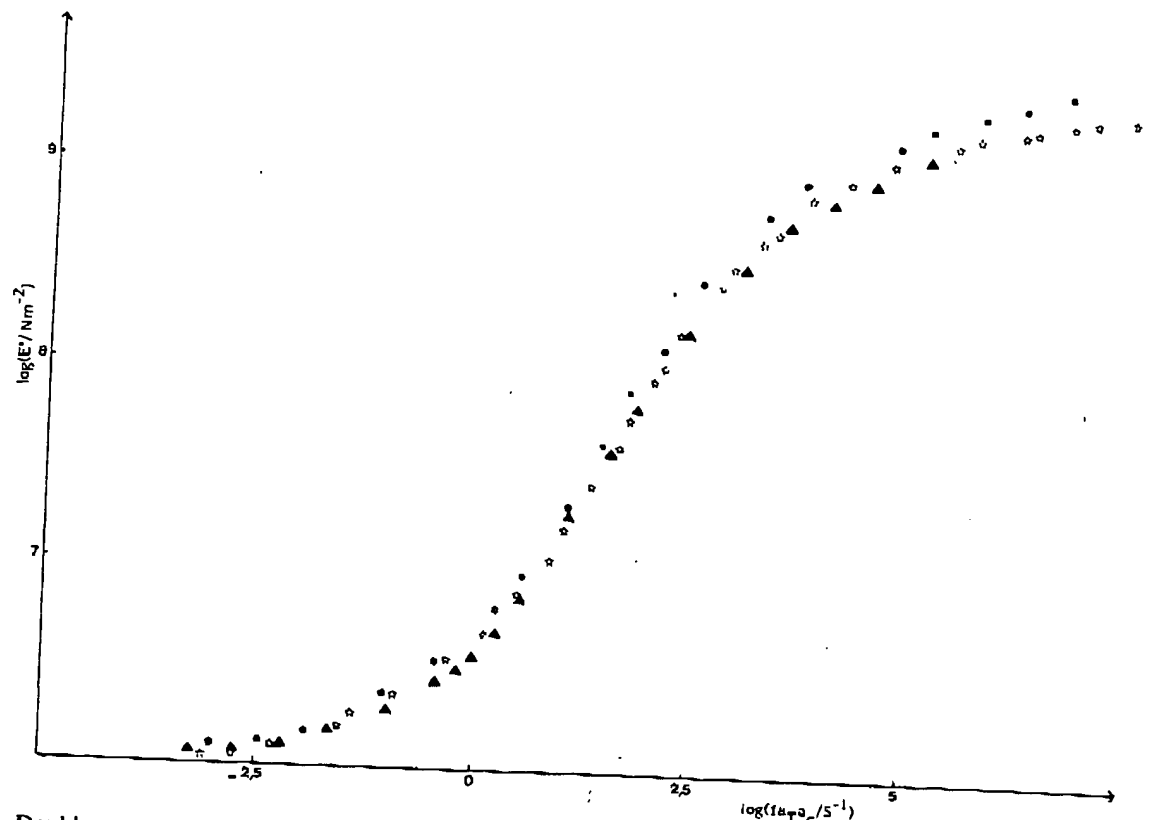


Fig. 7. Double master curve constructed from the three master curves (cf. Fig. 6) at different salt concentrations (cf. Table 3). The reference temperature is that corresponding to the maximum value of  $T_g$  in each case.  $a_c$  is the shift factor with respect to the salt concentration, viz.  $a_c = \tau(c)/\tau(c_0)$  taken at the reference temperature with  $c_0$  as reference concentration.

for a given anion; (v) the anion for a given alkali metal cation; and (vi) the overall nature of the ionic moiety, i.e. added salt or ionomers.<sup>18,25,28</sup>

If the large body of evidence gathered in this study leaves no doubt about the free-volume origin of the ionic mobility, it is nevertheless important to point out that the measurements of ionic conductivity have provided another important insight into the microscopic interactions occurring within these systems. The ionic conductivity inside a polymer matrix is a function of both the concentration and the mobility of charged species. Because an increase in salt concentration induces an increase in the  $T_g$  of the network, the ionic mobility follows a trend opposite to that displayed by the abundance of charge carriers. In order to compensate for this dichotomy, it is necessary to correlate the measured conductivity values to the salt concentration at equal mobility, viz. at  $(T - T_g) = \text{constant}$ . When such plots are constructed, as shown in Fig. 8, three features become apparent: the linearity of the plots up to a critical salt concentration, the slope of these straight lines, and the occurrence of singularities above the critical concentration characterized by conductivity minima at specific values of the salt concentration.

These peculiarities have been analysed and interpreted quantitatively with a whole series of network-salt combinations.<sup>15,18,28</sup> Suffice it to say here that the slope of these log-log plots is related to the relative importance of a given equilibrium of ionic dissociation with respect to the others, i.e. the

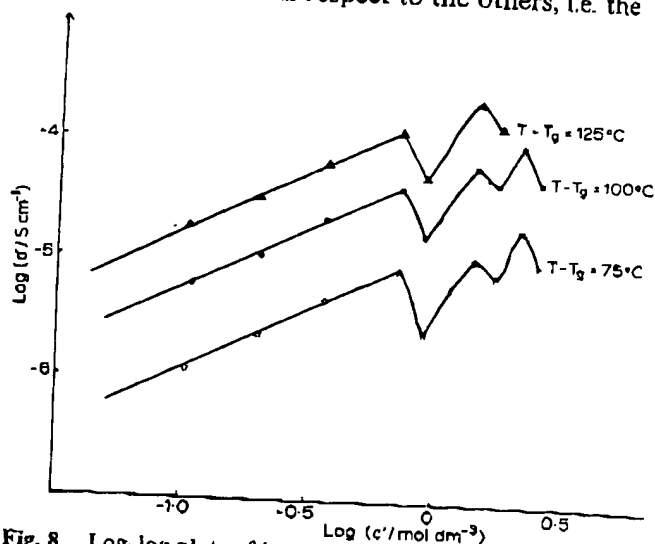
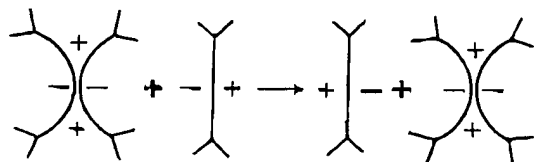


Fig. 8. Log-log plots of ionic conductivity  $\sigma$  versus  $\text{LiClO}_4$  concentration  $c$  for three values of  $T - T_g$ .

possible predominance of a specific set of species (single ions, ion pairs, triplets, quadrupoles, ...). For example, the situation shown in Fig. 8 gives a slope of unity which implies that the lithium perchlorate present below the critical concentration yields mostly quadrupoles.<sup>18,21,28</sup> This behaviour was found frequently in this study but is by no means general, other specific instances having also been observed.

The discontinuities, and in particular the minima of conductivity, were found to correspond to discrete values of the ratio between  $\text{Li}^+$  and ether units in the chains. In the specific context of Fig. 8, the first minimum corresponds to one  $\text{Li}^+$  per PEO chain ( $M_n = 1050$ ), i.e. to its partition into two segments of about 12 ethylene oxide units each. The second minimum corresponds to two  $\text{Li}^+$  per PEO chain, i.e. to a partition into three segments of about eight ethylene oxide units each. Similar observations were made with networks prepared with PEO of  $M_n = 2100$ .<sup>28</sup> The appearance of 'waves' such as those shown in Fig. 8 above the critical concentration, has been tentatively rationalized in terms of the attainment of ordered structures at each discrete ratio.<sup>28</sup>

The concept of ion-dipole crosslinking, already put forward and discussed in previous sections, as a rather static representation, is corroborated here in a more dynamic framework. The following model attempts a microscopic visualization of the nature of these polar interactions between ions and other dipoles in the polyether chains and of the way segmental motions can induce the displacement of mobile charged species from one site to the next. The importance of such ionic transfers will inevitably depend on the frequency and amplitude of segmental motions, i.e. on the free volume available. These phenomena are random and they give rise to statistical concentration fluctuations at a microscopic level. When a potential difference is applied across the sample, the ionic transfers obviously become unidirectional and thus ensure ionic transport across the material.



### 3.6 Transport numbers

When a few years ago Sorensen<sup>5</sup> first studied the cationic contribution to conductivity in a linear PEO and found transport numbers  $t_+$  lower than 0.5, these results were met with some surprise because it was expected instead that  $t_+$  should be close to unity. Since then, similar values have been obtained in

various laboratories and it is now generally accepted that the alkali metal cations contribute less than 50% of the ionic conductivity in a variety of systems.<sup>3</sup>

A first account of the determination of transport numbers within the context of crosslinked polyether networks was given in 1983.<sup>13</sup> Further work in this laboratory, always using Tubandt's technique, has been carried out on a considerable number of systems, but only published in part.<sup>17</sup>

**3.6.1  $t_+$  in ionomers.** In the extreme situation in which the anions are covalently bound to the network, it was verified that the cationic transport number was indeed unity.<sup>25</sup> This obvious result has the merit of showing the validity of the experimental technique adopted for the determination of transport numbers.

**3.6.2 Mobility of anions.** In order to dispel any residual doubt about the mobility of relatively large anions, e.g.  $\text{ClO}_4^-$ , within a polyether matrix, an experiment was carried out in which a disc of PEO-based network containing potassium perchlorate was submitted to a rather intense electrolysis. Thereafter, this sample was analysed by X-ray fluorescence (detection of emission from Cl atoms) and a concentration profile established concerning the distribution of perchlorate anions across the disk. Figure 9 shows the results obtained which indicate clearly that an important migration of  $\text{ClO}_4^-$  ions towards the anode had taken place during the electrolysis.

Having established this basic feature, a more quantitative study was conducted on the mobility of the  $\text{CF}_3\text{SO}_3^-$  (triflate anion) by a spin-echo n.m.r. technique using pulsed field gradients applied to the  $^{19}\text{F}$  nuclei. These experiments allowed the calculation of the self-diffusion coefficient of the anion ( $D^-$ ): for a PEO-based network containing 16% lithium triflate,  $D^-$  was found to be  $4.2 \times 10^{-8} \text{ cm}^2 \text{ s}^{-1}$  at 62°C. Swelling this system in chloroform produced an increase of the anionic self-diffusion coefficient of more than an order of magnitude.

The above tests demonstrate beyond doubt that typical anions do migrate readily inside a cross-linked polyether matrix.

**3.6.3 A systematic study of the cationic transport numbers.** Starting from a network system based on PEO and Desmodur R triisocyanate (Table 1), the influence of five variables was investigated in order to assess how  $t_+$  was affected by them.

The influence of temperature on  $t_+$  for a typical network containing  $\text{LiClO}_4$  was found to be



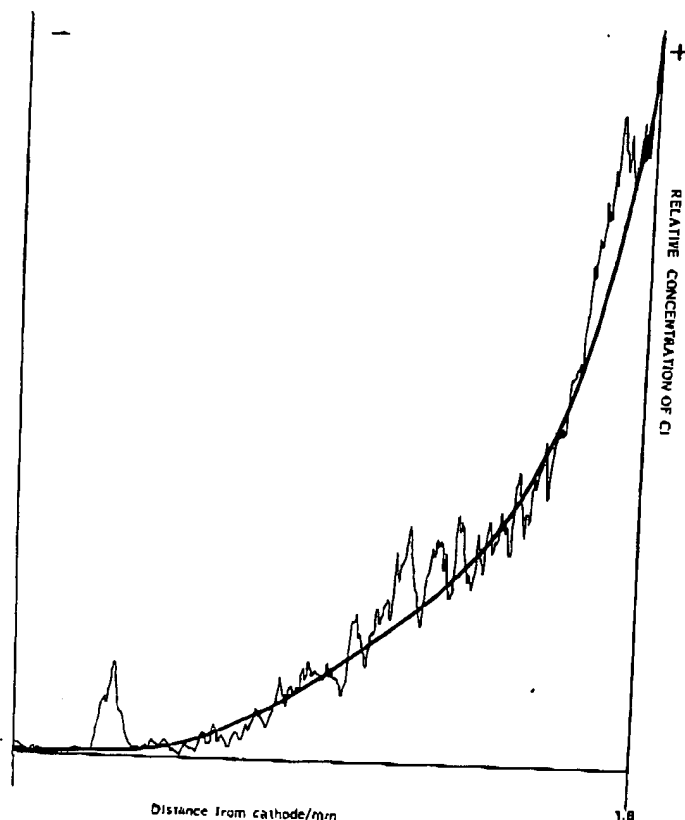


Fig. 9. Chlorine ( $\text{ClO}_4^-$ ) concentration profile across a disc of crosslinked PEO, originally containing a uniform concentration of  $\text{KClO}_4$ , after electrolysis. The plus and minus signs indicate the corresponding emplacements of the electrodes.

negligible, all values of  $t_+$  falling within  $\pm 0.02$  in the temperature range 60–120°C.

For a given network-salt system, an increase in concentration of the salt produced a decrease of  $t_+$  down to an asymptotic value. For example, with lithium perchlorate, Fig. 10 shows this trend, which is discussed below.

For a given network-salt combination, the DP of the PEO chains between crosslinks influences  $t_+$  in that an increase of DP induces a decrease of  $t_+$  as shown in Fig. 10. The two trends appearing in Fig. 10 reinforce the idea of chain partitioning by  $\text{Li}^+$ . Here, a discontinuity is again found (cf. conductivity results) at one  $\text{Li}^+$  per PEO chain ( $M_n = 1050$ ) and at three  $\text{Li}^+$  per PEO chain ( $M_n = 2100$ ). Beyond these critical salt concentrations,  $t_+$  becomes independent of this parameter. For a given network, the progressive increase in lithium perchlorate concentration produced a corresponding decrease in the number of ether sites available for complexation by  $\text{Li}^+$ . The 'saturation points' correspond to the most favourable partitioning situations. Beyond these critical concentrations, the additional salt goes preferentially to the existing complexed sites to form

TABLE 4. Influence of the cation on the anionic transport number

Salt	% [cation]/[EO] ratio	$t_-$
$\text{LiClO}_4$	2.8	0.30
$\text{NaClO}_4$	2.8	0.17
$\text{KClO}_4$	2.8	0.20
$\text{AgClO}_4$	2.8	0.30
$\text{Mg}(\text{ClO}_4)_2$	2.2	0

higher ionic aggregates. For a given  $\text{LiClO}_4$  concentration, the decrease of  $t_+$  with the molecular weight of the polyether chains can be explained tentatively by arguing that a progressive reduction of the mesh size introduces a corresponding decrease of the perchlorate anion mobility, given its much larger bulkiness compared with that of the lithium cation.

For a given situation characterized by a given network containing salts with a set concentration and the same anion, a change in the nature of the monovalent metal cation produced the variations in  $t_+$  shown in Table 4. The first important observation concerning these results is that the cationic transport number remains low for all situations studied. As for the influence of the type of cation on  $t_+$ , no explicit trend is apparent. In the same table is reported the datum related to the absence of contribution to ionic conductivity in the case of the magnesium cation. This result suggests that the use of a small divalent cation introduces a very strong binding with the PEO chains. A comparative measurement of swelling at equilibrium by benzene of two identical networks, one filled with lithium perchlorate, the other with magnesium perchlorate, showed that in order to attain the same  $q$  value, the molar concentration of lithium perchlorate had to be double that of magnesium perchlorate. The scheme proposed above for the transport of lithium and perchlorate ions by polyether segmental motions implies the existence of quadrupoles at the crosslink. The present observations relating to the use of magnesium perchlorate are more conducive to an interpretation calling upon the more straightforward strong interaction between one salt molecule (ion pair) and two ether oxygen atoms belonging to two PEO chains.

The influence of the nature of the anion on  $t_+$ , all other parameters being kept constant, is shown in Table 5 for two different sets of cations. The difference in the cationic transport number between sodium tetraphenyl borate and sodium perchlorate is readily explained in terms of the size of the anion.  $\text{BPh}_4^-$  has a volume about 15 times larger than that of  $\text{ClO}_4^-$  and as a consequence its transport number is likely to be reduced accordingly: the net result is

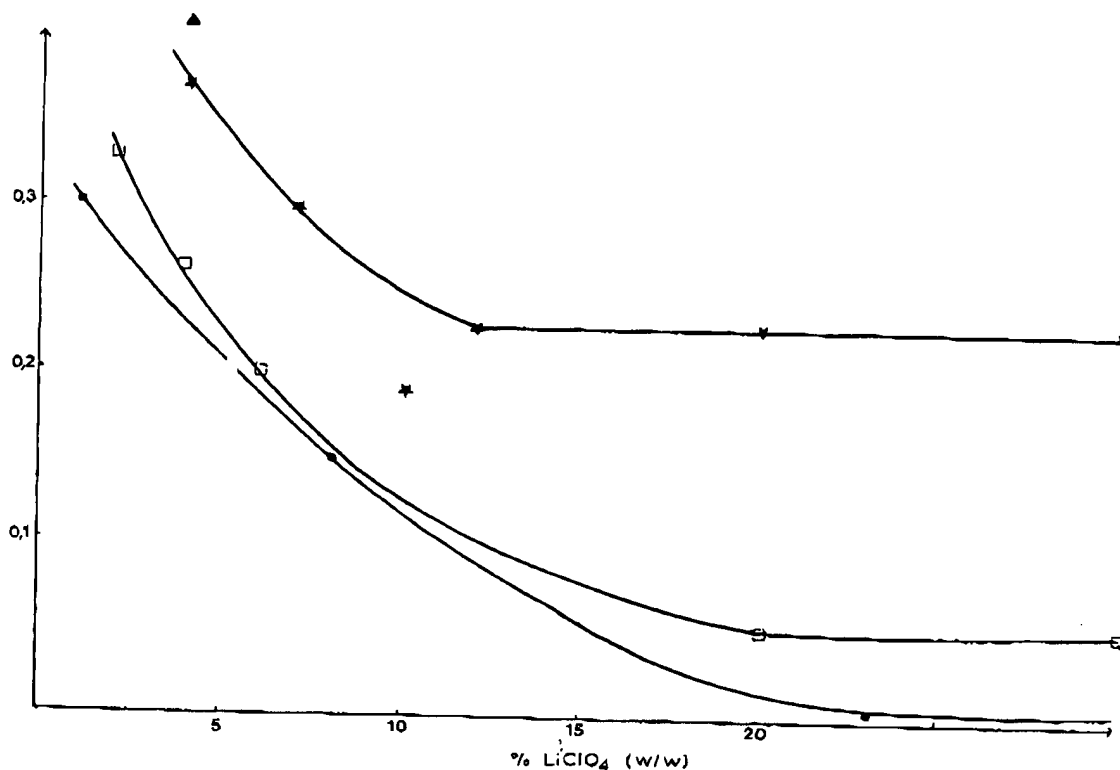


Fig. 10. Dependence of the cationic transport number on  $\text{LiClO}_4$  concentration with three different PEO-based networks.  $\blacktriangle$ , Networks based on PEO 420 and Desmodur R triisocyanate;  $\star$ , networks based on PEO 1050 and Desmodur R triisocyanate;  $\square$ , networks based on PEO 2100 and Desmodur R triisocyanate;  $\bullet$ , networks based on PEO-b-PPO-b-PEO ( $M_n = 4980$ ) and Desmodur R triisocyanate.

that  $t_+$  increases relative to the value obtained with the perchlorate anion (cf. also Table 4).

The three results with lithium salts reported in Table 5 can be rationalized as follows: the identity of behaviour between lithium perchlorate and lithium triflate is explained on the basis of the similar  $pK_a$  of the parent acids and a similar size for the two anions. The increase in the cationic transport number occurring when lithium trifluoroacetate was tested (a salt possessing again an anion of a size comparable with those discussed above), could be due to a different extent of ionization coupled with a competitive affinity of the ether groups of PEO chains and the trifluoroacetate anions towards the lithium cations.

TABLE 5. Influence of the anion on the cationic transport number

Salt	% [cation]/[EO] ratio	$t_+$
$\text{LiClO}_4$	4.1	0.22
$\text{LiSO}_3\text{CF}_3$	4.1	0.21
$\text{LiCO}_2\text{CF}_3$	4.1	0.63
$\text{NaBPh}_4$	2.8	0.50
$\text{NaClO}_4$	2.8	0.17

Networks made up of polyether chains other than PEO were also investigated. The precursors were poly(propylene oxide) (PPO) glycols, PEO-b-PPO-b-PEO glycols and PDMS-g(PPO-b-PEO) polyols (cf. Table 1). After crosslinking with various multifunctional isocyanates, different metal salts were added. With PPO-based networks, the cationic transport number was systematically somewhat higher than with the corresponding PEO-based networks containing the same salts. Thus for example, under identical conditions,  $t_+$  was  $0.40 \pm 0.02$  instead of  $0.31 \pm 0.02$  for the lithium cation. With the other networks, the values of  $t_+$  were close to those measured in the context of PEO-based networks under the same conditions.

**3.6.4 Conclusion.** It can be asserted that it is now clear that most of the systems which represent interesting materials for the construction of solid-state batteries and which involve the combination of a polyether-based network plus an added salt are inevitably characterized by very low  $t_+$  values, more often in the range of about 0.2 than around 0.5. This is not an artefact since the ionomers gave the correct answer of  $t_+ = 1$  and no cationic conductance was observed with the magnesium cation. It follows that

### Crosslinked polyethers as media for ionic conduction

265

in order to reach an optimum performance of these solid electrolytes, the most adequate solution seems to be that of employing networks in which the cation is mobile whereas the anion is covalently bound as an intrinsic part of their structure.

### 3.7 Nuclear magnetic relaxation

Previous experiments in this laboratory concerning nuclear magnetic relaxation measurements dealt with  $^7\text{Li}$ , from lithium perchlorate as added salt,<sup>11</sup> as well as  $^1\text{H}$ ,  $^{11}\text{B}$  and  $^{19}\text{F}$ , respectively, from the polyether chains, sodium tetraphenyl borate and lithium triflate.<sup>15</sup> A short outline of more recent work has already been given.<sup>19</sup>

**3.7.1 Relaxation of chain protons.** A systematic investigation of the transversal relaxation ( $T_2^{-1}$ ) of  $^1\text{H}$  nuclei belonging to the PEO chains in networks containing lithium perchlorate<sup>29</sup> has shown that the salt has a stiffening effect on the network, thus confirming the corresponding increase in the glass transition temperature reported and discussed above. These results reaffirm the occurrence of interactions between lithium cations and polyether segments. A more detailed study showed that chain

partitioning could be demonstrated independently by the present technique. Interestingly, Fig. 11 shows that this feature manifested itself as a wave-like function when the relaxation of protons was measured at high temperature, just as with the conductivity results at high salt concentration (cf. Fig. 8 and appropriate discussion). Here too, the minima in Fig. 11 correspond to one, two and three lithium cations per PEO chain ( $M_n = 1050$ ), respectively. Both phenomena, which represent two alternative ways of observing the same microstructure, were only detected when operating at relatively high temperature, viz. above about 65°C. Measurements of the dielectric constant of these salt-plus-network systems using complex impedance diagrams indicated that  $\epsilon$  increased dramatically when the temperature was increased. For example, the dielectric constant goes from  $\sim 8$  at 20°C to  $\sim 500$  at 70°C for a PEO-based network containing somewhat less than one lithium cation per PEO chain (the salt used was lithium perchlorate). This abrupt change with increasing temperature reflects the partial transformation of ionic quadrupoles around an ion-dipole crosslink characterized by a low overall polarity (see scheme above), into dipoles which on the contrary impart a high polarity to their surroundings.

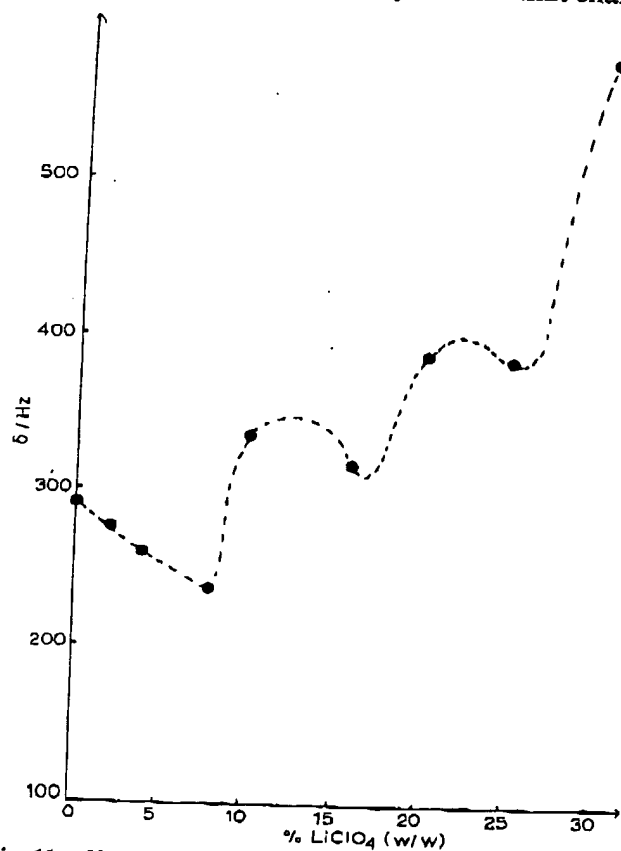


Fig. 11. Variations of the rate of transversal magnetic relaxation of PEO  $^1\text{H}$  as a function of  $\text{LiClO}_4$  concentration in a network based on PEO 1050 ( $T = 343\text{ K}$ ).

**3.7.2 Linewidth of lithium nuclei.** The magnetic relaxation of  $^7\text{Li}$  nuclei, detected through the linewidth  $\delta$  of its resonance as a function of temperature, was studied with various networks based on PEO-b-PPO-b-PEO and PDMS-g(PPO-b-PEO) containing lithium perchlorate at different concentrations. Figure 12 is an Arrhenius-type plot for one such system. Towards the lower temperature regime, i.e. below the glass transition temperature of the system, the linewidth is high and constant and its value is close to that exhibited for  $^7\text{Li}$  nuclei in metallic lithium. In this region the segmental motions are frozen and the spin-spin relaxation of the lithium nuclei is fast. As the temperature is increased,  $\delta$  is reduced in the region corresponding to the glass transition. The narrowing of the linewidth is due to the incipient segmental motions which also entail the lithium cations. Finally, at still higher temperatures  $\delta$  reaches a limiting lower value imposed artificially by instrumental effects, e.g. field inhomogeneity. The features noted here for Fig. 12 were also encountered with all other systems studied.

A WLF treatment of the transition zone of curves like those shown in Fig. 12, using a relaxation model based on free volume considerations rather than on activation energy, gave  $C_1 = 8 \pm 1$  and  $C_2 = 55 \pm 5\text{ K}$ , viz. values in close agreement with those obtained from both viscoelasticity and conductivity measurements.

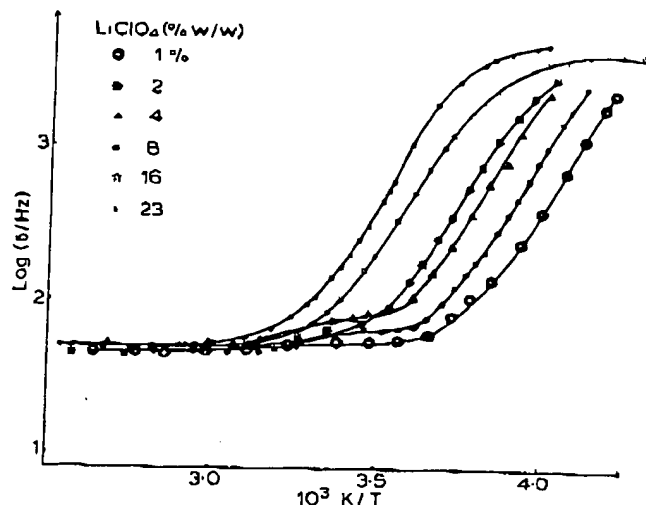


Fig. 12. Arrhenius-type plot of  $^7\text{Li}$  n.m.r. linewidth for networks based on PEO-b-PPO-b-PEO ( $M_n = 4980$ , see Table I) containing different concentrations of  $\text{LiClO}_4$ .

### 3.8 Electrochemical stability and applications

It is obvious that the possible use of these conducting systems as electrolytes for solid-state cells requires the study of their range of redox stability. In fact, the electrolyte must play exclusively its specific role as medium for the transport of ionic carriers between the two electrodes without suffering any modification induced by electrochemical reactions upon it. In the present investigation, tests were carried out using classical cyclic voltammetry techniques.<sup>14,20</sup> The materials tested consisted of polyether-urethane networks containing lithium perchlorate.

Figure 13 shows a typical cycle: the stability limits are clearly imposed by the reduction potential of the lithium cation on one side and by the oxidation potential of the perchlorate anion on the other. This gives a useful stability range of about 4 V. In all these experiments no electrochemical process pertaining to the electrolyte or affecting it was ever detected. This is an important practical finding which suggests that the polyether-urethane networks chosen are stable. In order to confirm this conclusion, dry samples of networks with and without added salt were placed in contact with metallic lithium by pressing them together under an argon atmosphere for 1 month. After this prolonged adhesion the two elements were separated: the lithium surface appeared unchanged and the networks exhibited the same electrical and mechanical properties as tested before the experiment. Thus, it seems reasonable to conclude that these materials and more particularly the urethane groups are electrochemically inert in the conditions relevant to the present context.

It became therefore appropriate to examine the

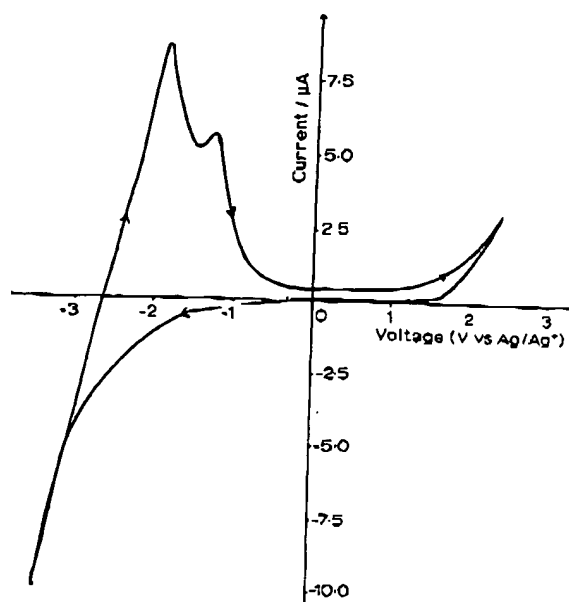
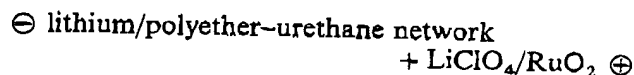


Fig. 13. Cyclic voltammetry applied to a network based on PEO ( $M_n = 2100$ ) and Desmodur R triisocyanate, containing 20% (w/w)  $\text{LiClO}_4$ . Sweep rate:  $40 \text{ mV s}^{-1}$ ;  $T = 343 \text{ K}$ . The small peak near  $-1 \text{ V}$  which follows the reoxidation of Li is due to the well-known Li-Pt alloy (the working electrode was made of Pt).

response of these materials as solid electrolytes in a proper battery set-up since they coupled high ionic conductivities with electrochemical stability. The cell adopted was<sup>14,20</sup>



where  $\text{RuO}_2$  was the material used as insertion electrode for lithium cations. From the behaviour recorded with two cycles of discharge-charge, it was concluded that the polymer-salt systems showed a good performance. Their application seems therefore entirely possible although the maximum current densities allowed were lower than  $100 \mu\text{A cm}^{-2}$ . This limitation is a direct result of the fact that the ionic transport in these systems is mostly due to the anion and thus justifies the research work on ionomeric networks. Our activity has been outlined in the various sections above. The results seem encouraging as shown in Fig. 14 where conductivity plots obtained with different ionomeric networks are compared with the behaviour of a typical network-plus-salt system under similar conditions and with the same cation. The values with dry phosphate and thiophosphate anions are rather low, but can be enhanced by swelling with an appropriate polar liquid. Anions simulating the trifluoroacetate anion also give relatively low conductivities because of the modest degree of dissociation to give free lithium cations. The alcoholates complexed with a Lewis

# Crosslinked polyethers as media for ionic conduction

267

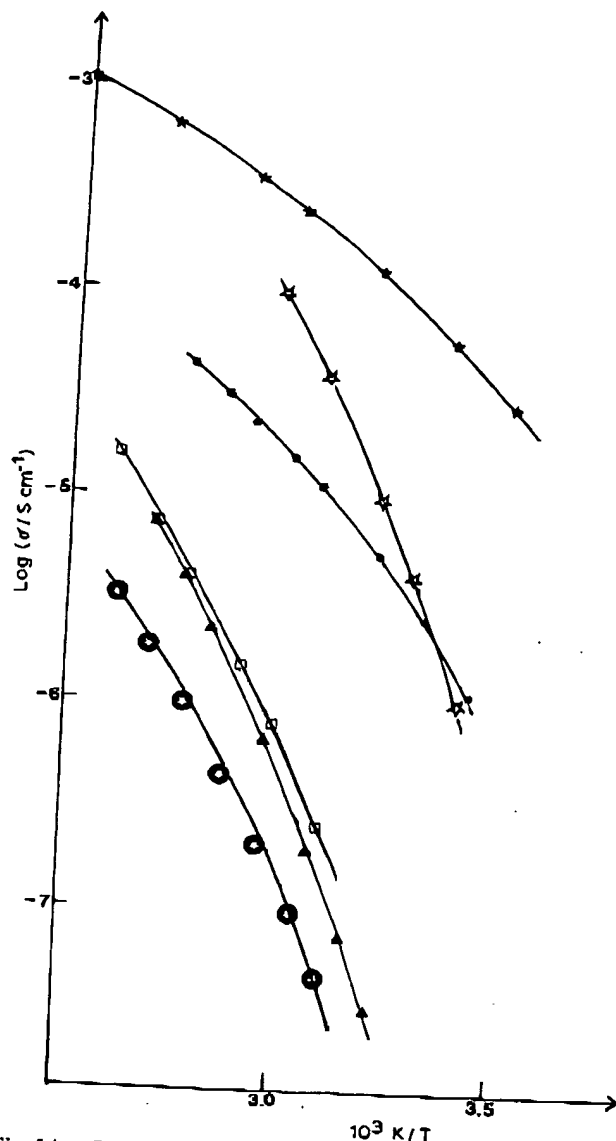


Fig. 14. Comparison of the conductivity behaviour of various ionic networks with that of a network-plus-salt system. ★, Polyether network based on PEO-b-PPO-b-PEO ( $M_n = 8390$ , see Table 1) containing 12%  $\text{LiClO}_4$  (w/w).<sup>28</sup> ●, polyether-phosphate network with  $\text{Li}^+$ .<sup>25</sup> ☆, system swollen with 40% propylene carbonate (w/w).<sup>25</sup> ▲, polyether network based on PPO triol (see Table 1) containing lithium alcoholate functions dissociated by  $\text{SbCl}_5$  (see Experimental part).<sup>26</sup> □, polyether network based on PPO triol (see Table 1) containing  $-(\text{CF}_2)_3\text{COO}^- \text{Li}^+$  functions (see Experimental part).<sup>26</sup> □, polyether-thiophosphate network with  $\text{Li}^+$ .<sup>25</sup>

acid give the most satisfactory results although clearly more work is needed to attain the desired performance.

## 4 CONCLUSIONS

This investigation has provided a much deeper understanding of the properties and behaviour of

solid electrolytes consisting of polyether-urethane networks with either a dissociated salt added to them or anionic moieties covalently attached to their structure with the cationic counterparts free to move within the polymeric matrix.

In particular, it has become clear that the free volume theory (WLF) of polymeric matter above the glass transition temperature applies to these systems in the specific context of the mobility and transport of ionic species. This was proven by the excellent agreement found for the values of the  $C_1$  and  $C_2$  WLF coefficients obtained from very different experimental approaches, not only the classical viscoelastic measurements but also the conductivity data and magnetic relaxation results pertaining to nuclei of both the polymer chains and the added salts. It follows that one of the basic criteria to attain a high ionic conductivity is a system with as low a glass transition temperature as possible. Coupled with this concept, one must of course take into account two other basic requirements: the solubility or thermodynamic compatibility between network and salt and the high degree of dissociation of the salt. The systems chosen here responded quite adequately to these guidelines, as shown by their satisfactory performance as solid electrolytes in a battery set-up.

The only drawback lies of course in the surprisingly low contribution of the cations to the overall ionic conductivity in the context of networks in which the salts were added separately. The investigation programme on ionomeric networks with fixed anions was conceived and initiated precisely to improve this situation, whilst keeping the other advantages at optimum level. This activity is still being pursued.

On a more fundamental basis, the multidisciplinary approach which characterized this project also proved particularly rewarding. It was in fact possible to draw important conclusions concerning the interactions between ionic entities arising from the added salts and the ether groups on the polymer chains and concerning the nature and relative proportion of different ionic aggregates as a function of the major variables. The combination of all these pieces of information provided a valuable insight into the way ions can move within the polymeric network. Segmental motions of chains bearing complexed ionic moieties lead to possible concerted exchanges of the type

doublet + quadrupole  $\rightarrow$  quadrupole + doublet

The ensuing charge fluctuation (provided by specific anionic or cationic point defaults) becomes an oriented migration when an electric field is applied across the sample. The anions are transported more readily than the cations if both entities are free to

move and if the former are not too bulky. This is due to the fact that anions are less subject to complexation with elements of the polymer chain than cations.

As expected, if the anions are chemically anchored to the network structure, only cationic transport is observed. This situation deserves further study because it represents the best potential for future application. Work is in progress to fulfil that aim.

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